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A Study of the
Continuous
Steam Engine Indicator

Mechanical Engineering
B. S.

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A STUDY OF THE CONTINUOUS STEAM ENGINE INDICATOR

BY

HUGO LUND

THESIS FOR DEGREE OF BACHELOR OF SCIENCE
IN MECHANICAL ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS

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1902
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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Hugo Lund

ENTITLED A Study of a Continuous Steam Engine Indicator

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Mechanical Engineering

L. P. Brackernidge

HEAD OF DEPARTMENT OF Mechanical Engineering

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A STUDY OF THE CONTINUOUS STEAM ENGINE INDICATOR.



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A STUDY OF THE CONTINUOUS STEAM ENGINE INDICATOR.

It is, of course an undeniable fact that the determination of the average performance of steam, gas or other engines is in many respects an approximation. In conducting such tests it is the usual custom to employ a number of observers who, at stated intervals or at a predetermined signal, take simultaneous readings of various instruments, the interval between readings varying from one to fifteen minutes according to the nature of the test. The readings so obtained are arranged or otherwise "worked up" and the results are accepted as indicative of the true average performance of the engine during the test.

In case the conditions remain fairly uniform during the test or if the changes are gradual, extending over several readings, this method may give results accurate enough for any practical purpose; if, however the changes are frequent and considerable in amount, these readings may or may not represent the average conditions since the previous observation and a factor of uncertainty is introduced into the results.

In the determination of the average horse power of an engine by means of cards taken with the ordinary form of indicator the average of the horse-powers obtained from the various cards is taken to be the true average horse-power developed during the test, despite the fact that between readings a great variation of load may have taken place. There is of course a limit to the number of cards that can be taken in a given time. For this reason results obtained from these cards must be in a measure approximate.

The desire to avoid all approximation and to get results

absolutely correct led to the design of various kinds of continuous^{2.} indicators. These vary in constructive details but are of two general types; those which give a record on a strip of paper and those which record the result by means of a counter or dial.

* In the first class the most important feature is the mechanism for producing continuous forward motion of the record by means of the reciprocating motion of the engine piston. A continuous forward uniform motion is of course readily obtained; but when the card is to be used for any more than illustrative purpose, and even then, it is desirable that the rate of motion of the paper bears a constant ratio to that of the piston.

A sketch of one form of continuous indicator is shown in Fig. 1. On the left of the sketch the cylinder of an ordinary indicator with its recording levers will be seen. The recording pen is shown in contact with a paper ribbon, F, near its lower edge. This ribbon is drawn from a drum, G, (Fig. 2.) carried around an idler cylinders at I and wound on a drum H. The rate of motion of the paper is controlled by the cylinder

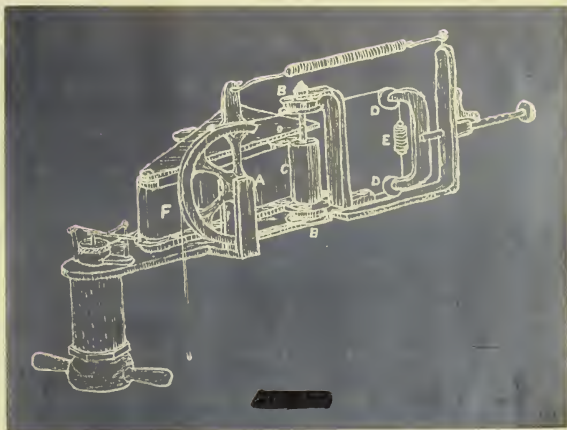
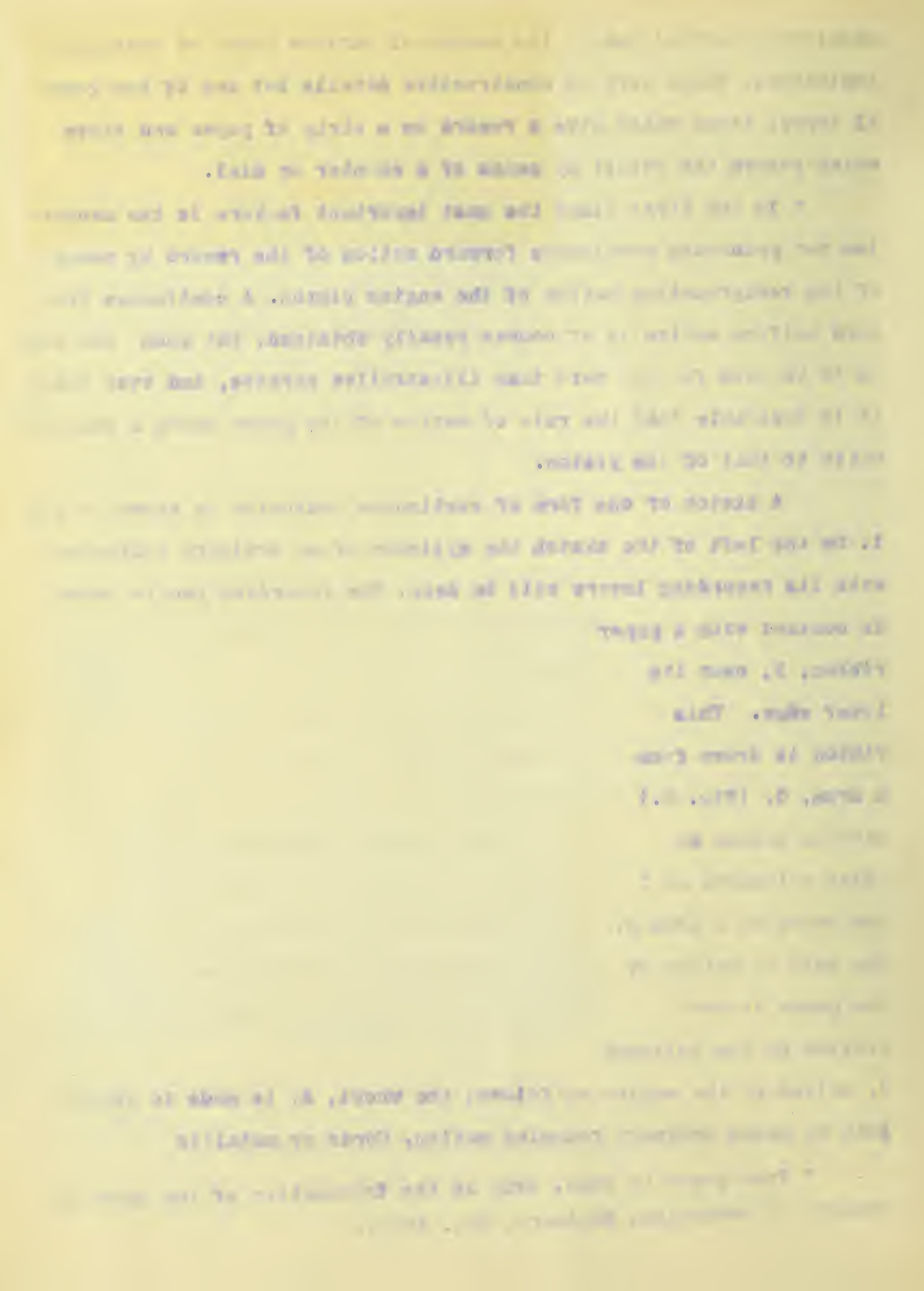


Figure 1.

C, driven by the engine as follows; the wheel, A, is made to oscillate by means ordinary reducing motion. Cords or metallic

* From paper by Thos. Gray in the Transaction of the American Society of Mechanical Engineers, Vol. XVIII.



straps are attached to the upper and lower sides of the wheel, A, and carried in similar directions around the pulleys, B, B, which are fixed to the

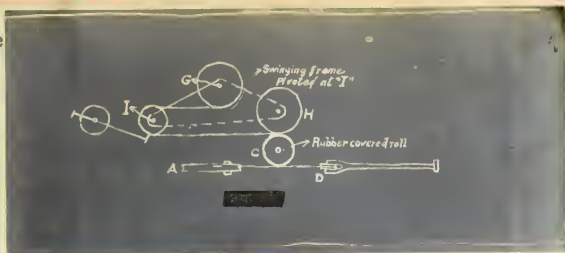


Figure 2

upper and the lower ends of the shaft carrying the cylinder, C. The free ends of these cords are then led around the pulleys, D, D, and joined by a spring E. The cylinder C will be given a clockwise rotation in consequence, the lower cord slipping on its pulley and acting as a strap brake to prevent excessive motion. When the motion of the wheel A is reversed the lower cord turns C in the same direction as that in which it was turned by the upper cord. So it will be seen that the reciprocating motion of the engine imparts to C a motion always in the same direction and proportional to the rate of motion of the engine piston.

The frame which carries the drums, G and H, swings around an axis at I, and is pressed toward the drum C, by a spring. The paper passes between the drum H and the cylinder C, and thus when C is turned the drum is caused to rotate and move the paper. Since the drum H is driven through the pressure of C on the paper as it comes from the idler I, and since C turns an equal amount for each stroke, the length of paper ribbon which passes the recording pen is also the same for each stroke no matter what amount of paper may be stored on the drum.

Figures 3, 4 and 5 show the continuous indicator in the laboratory of the University of Illinois. It is known as Brown's Recording Indicator and is of the type which registers its readings on a dial. The most important parts are a small drum, D, a wheel, W,

and the dial, C. The drum D is moved backward and forward parallel to its axis by means of a common reducing motion, the cord by which it is attached to the reducing motion causing it to move in one direction and the



Figure 3.



Figure 4.

spring S causing its motion in the others. At the same time the wheel W has its plane, which is normally parallel to the axis of the drum, turned through an angle proportional to the difference in the steam pressures on the two sides of the engine piston by means of

an indicator piston which is connected to a short arm fixed to the frame in which the wheel, W, turns. As the drum moves backward and forward, the wheel causes it to revolve about its axis by an amount depending upon the

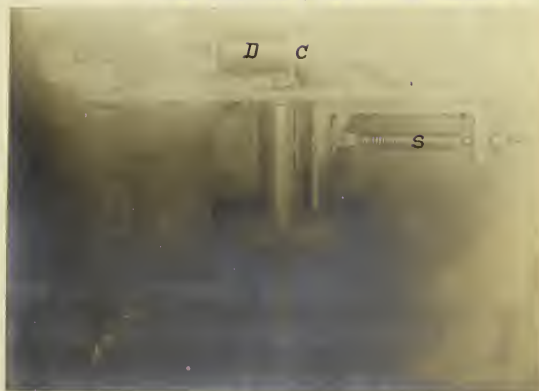


Figure 5.

inclination of the wheel and the stroke of the drum. The number of revolutions shown by the dial is thus proportional to the work done by the engine.

It is at once apparent that the use of some form of continuous indicator would greatly reduce the labor involved in working up the horse power developed during a test. The time and work required to determine the horse power of an engine are of considerable moment where tests are long in duration or great in number. This being the case, this thesis was undertaken with the end in view of determining the measure of accuracy of the Brown Recording Indicator owned by the University of Illinois.

The original intention was to compare the results obtained from the continuous indicator with those gotten by working up cards taken during the test by means of ordinary steam engine indicators. The work had not progressed far, however, before the following question was raised. How does a change in the time between cards effect the results, and can the results obtained from cards taken at intervals be justly compared with those gotten by the use of a continuous indicator? In order to throw some light upon the question the thesis was divided into parts;

(A) The effect on the result for average horse power of the method of taking cards and of the interval between readings.

(B) Tests of the continuous steam engine indicator. Each of these parts will be seperately treated.

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BETWEEN READINGS.

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The Effect on the Result for Average Horse-power of the Method of Taking Cards and of the Interval Between Readings.

In order to obtain the data necessary for this investigation a test of seven and one half hours duration was run on the 10"x16" x 12" Tandem Compound Ideal Engine in the laboratory of the University of Illinois.

At intervals of two minutes cards were taken simultaneously from each end of both the high pressure and the low pressure cylinder. At the same time readings were taken of the revolutions per minute of the engine and also of such ammeters and voltmeters as would make possible the calculation of the electric load; the engine tested being used to run the dynamos supplying the light and power required about the University buildings.

The complete results obtained from this test are set forth in the following tables, numbered from one to twenty-five.

Table number one is the electrical log of the test. It gives the readings of the voltmeter and the two ammeters. From these readings the electric load was computed.

Table number two gives the electric load (in horse-power) for each two minute interval during the test.

Table number three is a record of the revolutions per minute of the engine during the test.

Table number four is a record of the mean effective pressure and of the indicated horse power developed in each cylinder during the test. All cards are taken simultaneously at two minute intervals.

Figure 6 is a graphic representation of the results recorded in tables number two three and four. The curves show the variation throughout the test of the speed, the electrical load and

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Tables number five, six, seven, and eight, developed from table number four, show the horse power developed with cards taken simultaneously at intervals of four, six, eight, and ten minutes respectively.

Tables number nine, ten, eleven, twelve, and thirteen also developed from table number four, show the horse-power developed with cards taken in rotation at intervals of two, four, six, eight and ten minutes respectively. The cards are assumed to have been taken in the following order of rotation; high pressure head end, high pressure crank end, low pressure head end, low pressure crank end.

Tables number fourteen to number eighteen, inclusive, constitute Series A, developed from tables four to eight, inclusive, and intended to show the effect on the results for average horse power of the interval between readings, cards in all cases to be taken simultaneously.

Tables number nineteen to number twenty-three, inclusive, constitute Series B., developed from tables number four to number thirteen, inclusive, and intended to show the effect on the results for average horse power of the method of taking cards; ie., whether simultaneously or in rotation.

Tables number twenty-four and number twenty-four A, are a summary of the results of Series A. In table number twenty-four the results are given in terms of the average indicated horse power and in twenty-four A, by making the results for two minute intervals unity and expressing the results for other intervals as decimal parts thereof.

Tables number twenty-five and number twenty-five A, are

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Two hundred thousand copies of the book were printed, and it was distributed to all the libraries in the country. The book was also translated into many other languages, and it has been a great success.

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a summary of the results of Series B. In table number twenty-five the results are given in terms of the average indicated horse power and in twenty-five A, by making the results for simultaneous readings unity and expressing the results obtained by taking cards in rotation as decimal parts thereof.

Finally, the author would state that guided by the results as shown in tables twenty-four A, and twenty-five A, he has arrived at the following conclusions.

1. That an increase in the time intervals between readings will generally cause the result for average horse power to be lowered.

From table number twenty-four A, it may be seen that in only one case out of twenty-eight did an increase in the interval between readings give an increase average horse power compared with that for a two minute interval, and there the increase was only one tenth of one percent; while in the other twenty seven cases the results for average horse power were too low by amounts varying from three tenths of one percent to three and eight tenths percent, when similarly compared.

2. That when cards are taken in rotation at given intervals of time the results for average horse power will in general be somewhat smaller than when cards are taken simultaneously with the same interval.

From table number twenty-five A, it may be seen that in nine cases out of thirty-five the result for average horse power with cards taken in rotation exceeded the result obtained by taking cards simultaneously, the increase varying from one tenth of one percent to five and eight tenths percent; while in twenty-five cases the results for average horse power with cards taken in rotation were lower than the

results with cards taken simultaneously by amounts varying from two tenths of one percent to five and eight tenths percent. In one the results were identical.

3. That for ordinary work a change in the interval between readings (within reasonable limits) or in the method of taking cards will cause no very considerable error in the result for average horse power; but that when an extreme measure of accuracy is of great importance cards should be taken simultaneously and as often as may be possible.

TABLE I.
ELECTRICAL LOG.

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ELECTRICAL LOG.

Time	Am.M.	V.M.	Am.M.	Time	Am.M.	V.M.	Am.M.
	9090	9292	7061		9090	9292	7061
9-12	41	446	41	10-02	40	436	40.5
-14	41	445	41.5	-04	40	436	40.5
-16	41	443	41.5	-06	40.25	435	41
-18	41	442	41.5	-08	40.25	435	40.5
-20	40.25	442	41	-10	40.5	438	41
-22	40	442	40.5	-12	40.5	438	41
-24	40	442	41	-14	40.25	435	40.5
-26	40.25	441	40.5	-16	41	435	41
-28	40	441	40.5	-18	41.5	436	41.75
-30	40	440	40.5	-20	41	436	41.75
-32	40	440	40	-22	41	437	41.25
-34	40	440	40.25	-24	41.5	438	41.75
-36	40	438	40	-26	41.5	436	41.75
-38	40	437	40.25	-28	40.5	433	41
-40	40	437	40.25	-30	40.25	434	40.5
-42	40	438	40.5	-32	40.25	430	41.25
-44	40	440	41	-34	40.5	430	42
-46	40.25	440	41.25	-36	42.5	432	42.25
-48	40.25	440	41	-38	41.25	433.5	42.5
-50	40	440	40	-40	41.25	433.5	42.5
-52	40.5	438	40.75	-42	41	433.2	42.2
-54	40	437	40.5	-44	41	433.5	42
-56	40.5	440	41	-46	40.75	433.5	42
-58	40.25	440	41	-48	40.75	430	42
10-00	40.5	437	41	-50	40.75	432	41

Time	Am.M.	V.M.	Am.M.
	9090	9292	7061
10-52	41	431	42
-54	41	430	41.5
-56	40.5	430	41
-58	40.5	430	41
11-00	41	433	41.5
-02	41	433	41.5
-04	41	433	41.5
-06	40.5	431	41
-08	40.5	431	41
-10	40	430	40.5
-12	40	430	40.5
-14	39.5	429	40
-16	39.5	429	40
-18	40	430	40.1
-20	39.5	435	40
-22	39.5	435	40
-24	39.5	435	40
-26	39.5	433.5	40
-28	39.75	433.5	40.1
-30	39.75	433.5	40
-32	39.75	433.5	40
-34	39.5	433.5	40
-36	39.5	434	40
-38	39	433	39.75
-40	39	430	40
-42	39	431	40
-44	39	433	39.75

Time	Am.M.	V.M.	Am.M.
	9090	9292	7061
11-46	39	433	39.75
-48	39	433	39.75
-50	39	430	39.5
-52	39	430	39.75
-54	27.5	430	30
-56	29	429.5	29.5
-58	30	430	29
12-00		426	
-02		425	
-04		432	
-06		437	
-08		436	
-10		435	
-12		435	
-14		435	
-16		432	
-18		432	
-20		432	
-22		433	
-24		435	
-26		434	
-28		433	
-30		431	
-32		431	
-34		431	
-36		431	
-38		429	

19.00	19.01	19.02	19.03	19.04	19.05	19.06	19.07
1.00	2.00	3.00			1000	2000	3000
47.00	48.00	49.00	50-11		10	100	1000
47.01	48.01	49.01	50-		1.10	100	1000
47.02	48.02	49.02	50-		10	100	1.00
47.03	48.03	49.03	50-		10	100	1.00
48	48.04	49.04	50-		0.10	100	10-11
47.04	48.05	49.05	50-		0.10	100	10-
49	48.06	49.06	50-		0.10	100	10-
	48.07		50-12		10	100	1.00
	48.08		50-		10	100	1.00
	48.09		50-		1.00	100	10-
	48.10		50-		1.00	100	10-
	48.11		50-		00	100	1.00
	48.12		50-		00	100	1.00
	48.13		50-		00	100	1.00
	48.14		50-		1.00	100	10-
	48.15		50-		00	100	1.00
	48.16		50-		00	100	1.00
	48.17		50-		00	100	1.00
	48.18		50-		1.00	100	10-
	48.19		50-		00	100	1.00
	48.20		50-		00	100	1.00
	48.21		50-		00	100	1.00
	48.22		50-		1.00	100	10-
	48.23		50-		00	100	1.00
	48.24		50-		00	100	1.00
	48.25		50-		00	100	1.00
	48.26		50-		00	100	1.00
	48.27		50-		00	100	1.00
	48.28		50-		00	100	1.00
	48.29		50-		00	100	1.00
	48.30		50-		00	100	1.00
	48.31		50-		00	100	1.00
	48.32		50-		00	100	1.00
	48.33		50-		00	100	1.00
	48.34		50-		00	100	1.00
	48.35		50-		00	100	1.00
	48.36		50-		00	100	1.00
	48.37		50-		00	100	1.00
	48.38		50-		00	100	1.00
	48.39		50-		00	100	1.00
	48.40		50-		00	100	1.00
	48.41		50-		00	100	1.00
	48.42		50-		00	100	1.00
	48.43		50-		00	100	1.00
	48.44		50-		00	100	1.00
	48.45		50-		00	100	1.00
	48.46		50-		00	100	1.00
	48.47		50-		00	100	1.00
	48.48		50-		00	100	1.00
	48.49		50-		00	100	1.00
	48.50		50-		00	100	1.00
	48.51		50-		00	100	1.00
	48.52		50-		00	100	1.00
	48.53		50-		00	100	1.00
	48.54		50-		00	100	1.00
	48.55		50-		00	100	1.00
	48.56		50-		00	100	1.00
	48.57		50-		00	100	1.00
	48.58		50-		00	100	1.00
	48.59		50-		00	100	1.00
	48.60		50-		00	100	1.00
	48.61		50-		00	100	1.00
	48.62		50-		00	100	1.00
	48.63		50-		00	100	1.00
	48.64		50-		00	100	1.00
	48.65		50-		00	100	1.00
	48.66		50-		00	100	1.00
	48.67		50-		00	100	1.00
	48.68		50-		00	100	1.00
	48.69		50-		00	100	1.00
	48.70		50-		00	100	1.00
	48.71		50-		00	100	1.00
	48.72		50-		00	100	1.00
	48.73		50-		00	100	1.00
	48.74		50-		00	100	1.00
	48.75		50-		00	100	1.00
	48.76		50-		00	100	1.00
	48.77		50-		00	100	1.00
	48.78		50-		00	100	1.00
	48.79		50-		00	100	1.00
	48.80		50-		00	100	1.00
	48.81		50-		00	100	1.00
	48.82		50-		00	100	1.00
	48.83		50-		00	100	1.00
	48.84		50-		00	100	1.00
	48.85		50-		00	100	1.00
	48.86		50-		00	100	1.00
	48.87		50-		00	100	1.00
	48.88		50-		00	100	1.00
	48.89		50-		00	100	1.00
	48.90		50-		00	100	1.00
	48.91		50-		00	100	1.00
	48.92		50-		00	100	1.00
	48.93		50-		00	100	1.00
	48.94		50-		00	100	1.00
	48.95		50-		00	100	1.00
	48.96		50-		00	100	1.00
	48.97		50-		00	100	1.00
	48.98		50-		00	100	1.00
	48.99		50-		00	100	1.00

Time	Am.M.	V.M.	Am.M.	Time	Am.M.	V.M.	Am.M.
	9090	9292	7061		9090	9292	7061
12-40		430		1-34	41	450	41
-42		427		-36	40	450	41
-44		432		-38	40	451	40
-46		430		-40	40	450	40
-48		432		-42	41	450	41
-50		435		-44	40	450	41
-52		435		-46	41	450	41
-54		435		-48	40	450	41
-56		435		-50	40	450	41
-58		432		-52	40	451	41
1-00	15	435	15	-54	40	451	41
-02	15	435	15	-56	40	451	41
-04	15	435	15	-58	40	450	40
-06	15	435	15	2-00	41	451	41
-08	15	435	15	-02	40	451	41
-10	22	435	22	-04	40	450	41
-12	42	450	41	-06	40	447	41
-14	41	450	41	-08	40	446	41
-16	41	450	41	-10	40	446	41
-18	40	450	42	-12	40	447	41
-20	41	450	41	-14	40	448	40
-22	40	450	40	-16	40	448	40
-24	40	450	41	-18	40	448	40
-26	40	450	41	-20	40	447	40
-28	40	450	41	-22	40	446	40
-30	42	450	42	-24	44	448	44
-32	41	450	40	-26	40	446	41

1900	1901	1902	1903	1904	1905	1906	1907
29	062	12	85-1		062		86-12
30	063	04	85-		063		86-
31	163	04	85-		063		86-
32	064	04	86-		064		87-
42	065	11	86-		065		87-
43	066	08	86-		066		87-
44	067	13	86-		067		87-
45	068	04	87-		068		88-
46	069	09	87-		069		88-
47	169	08	87-		069		88-
48	169	05	87-	81	069	81	89-1
49	169	05	87-	81	069	81	89-
50	061	04	88-	81	069	81	89-
51	169	11	89-5	81	069	81	89-
52	062	04	89-	81	069	81	89-
53	063	04	90-	88	069	82	91-
54	715	04	90-	88	069	82	91-
55	915	05	90-	88	069	82	91-
56	915	04	91-	88	069	82	91-
57	719	04	91-	88	069	82	91-
58	915	05	91-	88	069	82	91-
59	915	05	91-	88	069	82	91-
60	719	05	92-	88	069	82	91-
61	715	04	92-	88	069	82	91-
62	915	04	93-	88	069	82	91-
63	915	04	93-	88	069	82	91-

Time	Am.M.	V.M.	Am.M.
	9090	9292	7061
2-28	40	447	41
-30	40	446	41
-32	40	445	41
-34	40	446	40
-36	40	446	40
-38	41	446	41
-40	40	446	41
-42	40	447	40
-44	42	447	42
-46	45	447	42
-48	43	447	41
-50	43	447	41
-52	43	447	41
-54	60	448	60
-56	61	447	62
-58	60	447	60
3-00	61	447	61
-02	61	447	61
-04	63	447	63
-06	63	447	63
-08	63	447	63
-10	61	447	61
-12	60	446	60
-14	61	446	62
-16	58	445	60
-18	59	446	59
-20	59	445	62

Time	Am.M.	V.M.	Am.M.
	9090	9292	7061
3-22	60	445	62
-24	62	446	64
-26	64	446	66
-28	69	447	70
-30	70	448	72
-32	69	447	70
-34	69	447	70
-36	69	447	70
-38	69	447	70
-40	69	447	70
-42	69	447	70
-44	69	447	70
-46	69	447	70
-48	70	448	72
-50	69	447	70
-52	69	447	70
-54	69	447	70
-56	69	448	70
-58	69	447	70
4-00	72	448	75
-02	72	448	74
-04	72	448	74
-06	73	448	74
-08	72	448	72
-10	71	448	74
-12	72	448	75
-14	73	448	76

Year	1971	1972	1973	1974	1975	1976	1977
1978	1979	1980	1981	1982	1983	1984	1985
1986	1987	1988	1989	1990	1991	1992	1993
1994	1995	1996	1997	1998	1999	2000	2001
2002	2003	2004	2005	2006	2007	2008	2009
2010	2011	2012	2013	2014	2015	2016	2017
2018	2019	2020	2021	2022	2023	2024	2025
2026	2027	2028	2029	2030	2031	2032	2033
2034	2035	2036	2037	2038	2039	2040	2041
2042	2043	2044	2045	2046	2047	2048	2049
2050	2051	2052	2053	2054	2055	2056	2057
2058	2059	2060	2061	2062	2063	2064	2065
2066	2067	2068	2069	2070	2071	2072	2073
2074	2075	2076	2077	2078	2079	2080	2081
2082	2083	2084	2085	2086	2087	2088	2089
2090	2091	2092	2093	2094	2095	2096	2097
2098	2099	2100	2101	2102	2103	2104	2105
2106	2107	2108	2109	2110	2111	2112	2113
2114	2115	2116	2117	2118	2119	2120	2121
2122	2123	2124	2125	2126	2127	2128	2129
2130	2131	2132	2133	2134	2135	2136	2137
2138	2139	2140	2141	2142	2143	2144	2145
2146	2147	2148	2149	2150	2151	2152	2153
2154	2155	2156	2157	2158	2159	2160	2161
2162	2163	2164	2165	2166	2167	2168	2169
2170	2171	2172	2173	2174	2175	2176	2177
2178	2179	2180	2181	2182	2183	2184	2185
2186	2187	2188	2189	2190	2191	2192	2193
2194	2195	2196	2197	2198	2199	2200	2201
2202	2203	2204	2205	2206	2207	2208	2209
2210	2211	2212	2213	2214	2215	2216	2217
2218	2219	2220	2221	2222	2223	2224	2225
2226	2227	2228	2229	2230	2231	2232	2233
2234	2235	2236	2237	2238	2239	2240	2241
2242	2243	2244	2245	2246	2247	2248	2249
2250	2251	2252	2253	2254	2255	2256	2257
2258	2259	2260	2261	2262	2263	2264	2265
2266	2267	2268	2269	2270	2271	2272	2273
2274	2275	2276	2277	2278	2279	2280	2281
2282	2283	2284	2285	2286	2287	2288	2289
2290	2291	2292	2293	2294	2295	2296	2297
2298	2299	2300	2301	2302	2303	2304	2305
2306	2307	2308	2309	2310	2311	2312	2313
2314	2315	2316	2317	2318	2319	2320	2321
2322	2323	2324	2325	2326	2327	2328	2329
2330	2331	2332	2333	2334	2335	2336	2337
2338	2339	2340	2341	2342	2343	2344	2345
2346	2347	2348	2349	2350	2351	2352	2353
2354	2355	2356	2357	2358	2359	2360	2361
2362	2363	2364	2365	2366	2367	2368	2369
2370	2371	2372	2373	2374	2375	2376	2377
2378	2379	2380	2381	2382	2383	2384	2385
2386	2387	2388	2389	2390	2391	2392	2393

Time	Am.M.	V.M.	Am.M.
	9090	9292	7061
4-16	72	448	75
-18	72	448	75
-20	75	449	78
-22	74	448	78
-24	76	447.5	80
-26	79	446	81
-28	78	445	80
-30	79	445	80
-32	77	442.5	78
-34	73	450	74
-36	72	447	73
-38	75	449	75
-40	76	449	76
-42	77	449	78
-44	74	449.5	72
-46	75	449.5	73
-48	75	449	73

Time	Am.M.	V.M.	Am.M.
	9090	9292	7061

TABLE II.
ELECTRICAL LOAD.

THE
JOURNAL OF THE
ROYAL ANTHROPOLOGICAL INSTITUTE

ELECTRICAL LOAD.

Time	H.P.	Time	H.P.	Time	H.P.	Time	H.P.
9-12	49.28	10-04	47.30	10-56	46.97	11-48	45.71
-14	49.47	-06	47.76	-58	46.97	-50	46.18
-16	49.14	-08	48.64	11-00	47.88	-52	45.39
-18	49.09	-10	48.06	-02	47.88	-54	33.14
-20	48.39	-12	48.10	-04	47.88	-56	33.64
-22	47.81	-14	48.70	-06	47.08	-58	34.50
-24	48.11	-16	48.07	-08	47.08	12-00	
-26	47.96	-18	48.91	-10	46.40	-02	
-28	47.84	-20	48.63	-12	46.40	-04	
-30	47.73	-22	48.39	-14	42.37	-06	
-32	47.43	-24	49.14	-16	45.70	-08	
-34	47.58	-26	48.91	-18	46.17	-10	
-36	47.22	-28	47.56	-20	46.35	-12	
-38	47.26	-30	47.24	-22	46.35	-14	
-40	47.26	-32	47.23	-24	46.35	-16	
-42	47.51	-34	47.80	-26	46.19	-18	
-44	48.03	-36	48.78	-28	46.40	-20	
-46	47.93	-38	48.79	-30	46.40	-22	
-48	48.32	-40	48.79	-32	46.34	-24	
-50	47.43	-42	49.65	-34	46.19	-26	
-52	47.96	-44	48.23	-36	46.23	-28	
-54	48.75	-46	48.08	-38	45.70	-30	
-56	48.33	-48	47.69	-40	45.53	-32	
-58	48.18	-50	47.34	-42	45.64	-34	
10-00	47.99	-52	47.95	-44	45.71	-36	
-02	47.30	-54	47.55	-46	45.71	-38	

TABLE 2-continued

1950	1951	1952	1953	1954	1955	1956	1957
17.04	18-02	19.55	20-02	21.73	22-02	23.04	24-02
25.04	26-02	27.55	28-02	29.73	30-02	31.04	32-02
33.04	34-02	35.75	36-02	37.55	38-02	39.04	40-02
41.04	42-02	43.75	44-02	45.55	46-02	47.04	48-02
49.04	50-02	51.75	52-02	53.55	54-02	55.04	56-02
57.04	58-02	59.75	60-02	61.55	62-02	63.04	64-02
65.04	66-02	67.75	68-02	69.55	70-02	71.04	72-02
73.04	74-02	75.75	76-02	77.55	78-02	79.04	80-02
81.04	82-02	83.75	84-02	85.55	86-02	87.04	88-02
89.04	90-02	91.75	92-02	93.55	94-02	95.04	96-02
97.04	98-02	99.75	100-02	101.55	102-02	103.04	104-02
105.04	106-02	107.75	108-02	109.55	110-02	111.04	112-02
113.04	114-02	115.75	116-02	117.55	118-02	119.04	120-02
121.04	122-02	123.75	124-02	125.55	126-02	127.04	128-02
129.04	130-02	131.75	132-02	133.55	134-02	135.04	136-02
137.04	138-02	139.75	140-02	141.55	142-02	143.04	144-02
145.04	146-02	147.75	148-02	149.55	150-02	151.04	152-02
153.04	154-02	155.75	156-02	157.55	158-02	159.04	160-02
161.04	162-02	163.75	164-02	165.55	166-02	167.04	168-02
169.04	170-02	171.75	172-02	173.55	174-02	175.04	176-02
177.04	178-02	179.75	180-02	181.55	182-02	183.04	184-02
185.04	186-02	187.75	188-02	189.55	190-02	191.04	192-02
193.04	194-02	195.75	196-02	197.55	198-02	199.04	200-02
201.04	202-02	203.75	204-02	205.55	206-02	207.04	208-02
209.04	210-02	211.75	212-02	213.55	214-02	215.04	216-02
217.04	218-02	219.75	220-02	221.55	222-02	223.04	224-02
225.04	226-02	227.75	228-02	229.55	230-02	231.04	232-02
233.04	234-02	235.75	236-02	237.55	238-02	239.04	240-02
241.04	242-02	243.75	244-02	245.55	246-02	247.04	248-02
249.04	250-02	251.75	252-02	253.55	254-02	255.04	256-02
257.04	258-02	259.75	260-02	261.55	262-02	263.04	264-02
265.04	266-02	267.75	268-02	269.55	270-02	271.04	272-02
273.04	274-02	275.75	276-02	277.55	278-02	279.04	280-02
281.04	282-02	283.75	284-02	285.55	286-02	287.04	288-02
289.04	290-02	291.75	292-02	293.55	294-02	295.04	296-02
297.04	298-02	299.75	300-02	301.55	302-02	303.04	304-02
305.04	306-02	307.75	308-02	309.55	310-02	311.04	312-02
313.04	314-02	315.75	316-02	317.55	318-02	319.04	320-02
321.04	322-02	323.75	324-02	325.55	326-02	327.04	328-02
329.04	330-02	331.75	332-02	333.55	334-02	335.04	336-02
337.04	338-02	339.75	340-02	341.55	342-02	343.04	344-02
345.04	346-02	347.75	348-02	349.55	350-02	351.04	352-02
353.04	354-02	355.75	356-02	357.55	358-02	359.04	360-02
361.04	362-02	363.75	364-02	365.55	366-02	367.04	368-02
369.04	370-02	371.75	372-02	373.55	374-02	375.04	376-02
377.04	378-02	379.75	380-02	381.55	382-02	383.04	384-02
385.04	386-02	387.75	388-02	389.55	390-02	391.04	392-02
393.04	394-02	395.75	396-02	397.55	398-02	399.04	400-02
401.04	402-02	403.75	404-02	405.55	406-02	407.04	408-02
409.04	410-02	411.75	412-02	413.55	414-02	415.04	416-02
417.04	418-02	419.75	420-02	421.55	422-02	423.04	424-02
425.04	426-02	427.75	428-02	429.55	430-02	431.04	432-02
433.04	434-02	435.75	436-02	437.55	438-02	439.04	440-02
441.04	442-02	443.75	444-02	445.55	446-02	447.04	448-02
449.04	450-02	451.75	452-02	453.55	454-02	455.04	456-02
457.04	458-02	459.75	460-02	461.55	462-02	463.04	464-02
465.04	466-02	467.75	468-02	469.55	470-02	471.04	472-02
473.04	474-02	475.75	476-02	477.55	478-02	479.04	480-02
481.04	482-02	483.75	484-02	485.55	486-02	487.04	488-02
489.04	490-02	491.75	492-02	493.55	494-02	495.04	496-02
497.04	498-02	499.75	500-02	501.55	502-02	503.04	504-02
505.04	506-02	507.75	508-02	509.55	510-02	511.04	512-02
513.04	514-02	515.75	516-02	517.55	518-02	519.04	520-02
521.04	522-02	523.75	524-02	525.55	526-02	527.04	528-02
529.04	530-02	531.75	532-02	533.55	534-02	535.04	536-02
537.04	538-02	539.75	540-02	541.55	542-02	543.04	544-02
545.04	546-02	547.75	548-02	549.55	550-02	551.04	552-02
553.04	554-02	555.75	556-02	557.55	558-02	559.04	560-02
561.04	562-02	563.75	564-02	565.55	566-02	567.04	568-02
569.04	570-02	571.75	572-02	573.55	574-02	575.04	576-02
577.04	578-02	579.75	580-02	581.55	582-02	583.04	584-02
585.04	586-02	587.75	588-02	589.55	590-02	591.04	592-02
593.04	594-02	595.75	596-02	597.55	598-02	599.04	600-02
601.04	602-02	603.75	604-02	605.55	606-02	607.04	608-02
609.04	610-02	611.75	612-02	613.55	614-02	615.04	616-02
617.04	618-02	619.75	620-02	621.55	622-02	623.04	624-02
625.04	626-02	627.75	628-02	629.55	630-02	631.04	632-02
633.04	634-02	635.75	636-02	637.55	638-02	639.04	640-02
641.04	642-02	643.75	644-02	645.55	646-02	647.04	648-02
649.04	650-02	651.75	652-02	653.55	654-02	655.04	656-02
657.04	658-02	659.75	660-02	661.55	662-02	663.04	664-02
665.04	666-02	667.75	668-02	669.55	670-02	671.04	672-02
673.04	674-02	675.75	676-02	677.55	678-02	679.04	680-02
681.04	682-02	683.75	684-02	685.55	686-02	687.04	688-02
689.04	690-02	691.75	692-02	693.55	694-02	695.04	696-02
697.04	698-02	699.75	700-02	701.55	702-02	703.04	704-02
705.04	706-02	707.75	708-02	709.55	710-02	711.04	712-02
713.04	714-02	715.75	716-02	717.55	718-02	719.04	720-02
721.04	722-02	723.75	724-02	725.55	726-02	727.04	728-02
729.04	730-02	731.75	732-02	733.55	734-02	735.04	736-02
737.04	738-02	739.75	740-02	741.55	742-02	743.04	744-02
745.04	746-02	747.75	748-02	749.55	750-02	751.04	752-02
753.04	754-02	755.75	756-02	757.55	758-02	759.04	760-02
761.04	762-02	763.75	764-02	765.55	766-02	767.04	768-02
769.04	770-02	771.75	772-02	773.55	774-02	775.04	776-02
777.04	778-02	779.75	780-02	781.55	782-02	783.04	784-02
785.04	786-02	787.75	788-02	789.55	790-02	791.04	792-02
793.04	794-02	795.75	796-02	797.55	798-02	799.04	800-02
801.04	802-02	803.75	804-02	805.55	806-02	807.04	808-02
809.04	810-02	811.75	812-02	813.55	814-02	815.04	816-02
817.04	818-02	819.75	820-02	821.55	822-02	823.04	824-02
825.04	826-02	827.75	828-02	829.55	830-02	831.04	832-02
833.04	834-02	835.75	836-02	837.55	838-02	839.04	840-02
841.04	842-02	843.75	844-02	845.55	846-02	847.04	848-02
849.04	850-02	851.75	852-02	853.55	854-02	855.04	856-02
857.04	858-02	859.75	860-02	861.55	862-02	863.04	864-02
865.04	866-02	867.75	868-02	869.55	870-02	871.04	872-02
873.04	874-02	875.75	876-02	877.55	878-02	879.04	880-02
881.04	882-02	883.75	884-02	885.55	886-02	887.04	888-02
889.04	890-02	891.75	892-02	893.55	894-02	895.04	896-02
897.04	898-02	899.75	900-02	901.55	902-02	903.04	904-02
905.04	906-02	907.75	908-02	909.55	910-02	911.04	912-02
913.04	914-02	915.75	916-02	917.55	918-02	919.04	920-02
921.04	922-02	923.75	924-02	925.55	926-02	927.04	928-02
929.04	930-02	931.75	932-02	933.55	934-02	935.04	936-02
937.04	938-02	939.75	940-02	941.55	942-02	943.04	944-02
945.04	946-02	947.75	948-02	949.55	950-02	951.04	952-02
953.04	954-02	955.75	956-02	957.55	958-02	959.04	960-02
961.04	962-02	963.75	964-02	965.55	966-02	967.04	968-02
969.04	970-02	971.75	972-02	973.55	974-02	975.04	976-02
977.04	978-02	979.75	980-02	981.55	982-02	983.04	984-02
985.04	986-02	987.75	988-02	989.55	990-02	991.04	992-02
993.04	994-02	995.75	996-02	997.55	998-02	999.04	1000-02

Time	H.P.	Time	H.P.	Time	H.P.	Time	H.P.
12-40		1-36	48.86	2-30	48.41	3-26	77.72
-42		-38	48.36	-32	48.30	-28	83.28
-44		-40	48.24	-34	47.82	-30	85.27
-46		-42	49.96	-36	47.82	-32	83.28
-48		-44	48.86	-38	49.02	-34	83.28
-50		-46	49.46	-40	48.42	-36	83.28
-52		-48	48.86	-42	47.83	-38	83.28
-54		-50	48.86	-44	50.33	-40	83.28
-56		-52	48.97	-46	52.13	-42	83.28
-58		-54	48.97	-48	50.33	-44	83.28
1-00	17.49	-56	48.97	-50	50.33	-46	83.28
-02	17.49	-58	48.24	-52	50.33	-48	85.27
-04	17.49	2-00	49.57	-54	72.06	-50	83.28
-06	17.49	-02	48.96	-56	75.04	-52	83.28
-08	17.49	-04	48.86	-58	71.90	-54	83.28
-10	24.31	-06	48.53	3-00	72.97	-56	83.47
-12	50.06	-08	48.41	-02	72.97	-58	83.28
-14	49.46	-10	48.41	-04	75.49	4-00	88.28
-16	49.46	-12	48.53	-06	75.49	-02	87.68
-18	49.46	-14	47.77	-08	75.49	-04	87.68
-20	49.46	-16	47.77	-10	72.97	-06	88.28
-22	48.24	-18	47.77	-12	71.74	-08	88.28
-24	48.86	-20	47.93	-14	73.53	-10	87.08
-26	48.86	-22	47.82	-16	70.39	-12	88.28
-28	48.86	-24	52.84	-18	70.54	-14	89.48
-30	50.67	-26	48.29	-20	72.04	-16	88.28
-32	48.86	-26	48.29	-22	72.77	-18	88.28
-34	49.46	-28	48.53	-24	75.33	-20	92.08

Year	Month	Day	Time	Location	Event	Result	Score
1977	01	01	00:00	00:00	00:00	00:00	00:00
1977	01	02	00:00	00:00	00:00	00:00	00:00
1977	01	03	00:00	00:00	00:00	00:00	00:00
1977	01	04	00:00	00:00	00:00	00:00	00:00
1977	01	05	00:00	00:00	00:00	00:00	00:00
1977	01	06	00:00	00:00	00:00	00:00	00:00
1977	01	07	00:00	00:00	00:00	00:00	00:00
1977	01	08	00:00	00:00	00:00	00:00	00:00
1977	01	09	00:00	00:00	00:00	00:00	00:00
1977	01	10	00:00	00:00	00:00	00:00	00:00
1977	01	11	00:00	00:00	00:00	00:00	00:00
1977	01	12	00:00	00:00	00:00	00:00	00:00
1977	01	13	00:00	00:00	00:00	00:00	00:00
1977	01	14	00:00	00:00	00:00	00:00	00:00
1977	01	15	00:00	00:00	00:00	00:00	00:00
1977	01	16	00:00	00:00	00:00	00:00	00:00
1977	01	17	00:00	00:00	00:00	00:00	00:00
1977	01	18	00:00	00:00	00:00	00:00	00:00
1977	01	19	00:00	00:00	00:00	00:00	00:00
1977	01	20	00:00	00:00	00:00	00:00	00:00
1977	01	21	00:00	00:00	00:00	00:00	00:00
1977	01	22	00:00	00:00	00:00	00:00	00:00
1977	01	23	00:00	00:00	00:00	00:00	00:00
1977	01	24	00:00	00:00	00:00	00:00	00:00
1977	01	25	00:00	00:00	00:00	00:00	00:00
1977	01	26	00:00	00:00	00:00	00:00	00:00
1977	01	27	00:00	00:00	00:00	00:00	00:00
1977	01	28	00:00	00:00	00:00	00:00	00:00
1977	01	29	00:00	00:00	00:00	00:00	00:00
1977	01	30	00:00	00:00	00:00	00:00	00:00
1977	01	31	00:00	00:00	00:00	00:00	00:00

Time	H.P.	Time	H.P.	Time	H.P.	Time	H.P.
4-22	91.28						
-24	93.59						
-26	95.65						
-28	94.25						
-30	94.97						
-32	94.94						
-34	88.67						
-36	86.88						
-38	90.26						
-40	90.41						
-42	93.29						
-44	87.97						
-46	89.31						
-48	89.07						

TABLE III.
REVOLUTIONS PER MINUTE.

THE SEVENTH
CHAPTER OF THE HISTORY

REVOLUTIONS PER MINUTE.

Time	R.P.M.	Time	R.P.M.	Time	R.P.M.	Time	R.P.M.
9-12	262	10-04	265	10-56	262	11-48	264
-14	266	-06	265	-58	263	-50	267
-16	262	-08	264	11-00	265	-52	267
-18	263	-10	266	-02	265	-54	267
-20	266	-12	265	-04	266	-56	270
-22	267	-14	269	-06	266	-58	265
-24	268	-16	266	-08	265	12-00	266
-26	266	-18	266	-10	263	-02	266
-28	266	-20	265	-12	265	-04	270
-30	266	-22	265	-14	262	-06	270
-32	269	-24	265	-16	264	-08	270
-34	264	-26	265	-18	265	-10	268
-36	264	-28	264	-20	267	-12	269
-38	267	-30	265	-22	267	-14	269
-40	267	-32	265	-24	266	-16	267
-42	266	-34	265	-26	267	-18	265
-44	267	-36	261	-28	267	-20	268
-46	267	-38	263	-30	268	-22	268
-48	266	-40	264	-32	264	-24	270
-50	266	-42	263	-34	267	-26	269
-52	265	-44	263	-36	267	-28	271
-54	262	-46	264	-38	265	-30	268
-56	267	-48	263	-40	264	-32	271
-58	266	-50	265	-42	265	-34	269
10-00	267	-52	264	-44	267	-36	267
-02	267	-54	262	-46	269	-38	263

Time	R.P.M.	Time	R.P.M.	Time	R.P.M.	Time	R.P.M.
12-40	267	1-36	265	2-32	263	3-28	267
-42	264	-38	264	-34	265	-30	263
-44	268	-40	266	-36	268	-32	260
-46	273	-42	267	-38	266	-34	263
-48	268	-44	264	-40	264	-36	259
-50	269	-46	268	-42	268	-38	262
-52	267	-48	264	-44	261	-40	261
-54	267	-50	264	-46	260	-42	257
-56	268	-52	264	-48	262	-44	260
-58	268	-54	264	-50	262	-46	263
1-00	268	-56	265	-52	262	-48	259
-02	268	-58	262	-54	262	-50	257
-04	267	2-00	262	-56	264	-52	262
-06	265	-02	262	-58	265	-54	264
-08	267	-04	263	3-00	266	-56	262
-10	266	-06	263	-02	264	-58	258
-12	266	-08	264	-04	263	4-00	262
-14	266	-10	263	-06	263	-02	261
-16	265	-12	266	-08	262	-04	262
-18	266	-14	261	-10	263	-06	263
-20	262	-16	265	-12	263	-08	261
-22	263	-18	264	-14	263	-10	259
-24	264	-20	264	-16	265	-12	259
-26	262	-22	263	-18	268	-14	260
-28	260	-24	264	-20	265	-16	261
-30	262	-26	268	-22	265	-18	262
-32	263	-28	267	-24	266	-20	263
-34	264	-30	262	-26	263	-22	259

Year	Age	Year	Age	Year	Age	Year	Age
1950	10-14	1951	10-14	1952	10-14	1953	10-14
1954	15-19	1955	15-19	1956	15-19	1957	15-19
1958	20-24	1959	20-24	1960	20-24	1961	20-24
1962	25-29	1963	25-29	1964	25-29	1965	25-29
1966	30-34	1967	30-34	1968	30-34	1969	30-34
1970	35-39	1971	35-39	1972	35-39	1973	35-39
1974	40-44	1975	40-44	1976	40-44	1977	40-44
1978	45-49	1979	45-49	1980	45-49	1981	45-49
1982	50-54	1983	50-54	1984	50-54	1985	50-54
1986	55-59	1987	55-59	1988	55-59	1989	55-59
1990	60-64	1991	60-64	1992	60-64	1993	60-64
1994	65-69	1995	65-69	1996	65-69	1997	65-69
1998	70-74	1999	70-74	2000	70-74	2001	70-74
2002	75-79	2003	75-79	2004	75-79	2005	75-79
2006	80-84	2007	80-84	2008	80-84	2009	80-84
2010	85-89	2011	85-89	2012	85-89	2013	85-89
2014	90-94	2015	90-94	2016	90-94	2017	90-94
2018	95-99	2019	95-99	2020	95-99	2021	95-99

Time	R.P.M.	Time	R.P.M.	Time	R.P.M.	Time	R.P.M.
4-24	259						
-26	252						
-28	250						
-30	246						
-32	238						
-34	251						
-36	249						
-38	252						
-40	260						
-42	260						
-44	264						
-46	268						
-48	262						

TABLE IV.
MEAN EFFECTIVE PRESSURE
and
INDICATED HORSE POWER
for
TWO MINUTE INTERVALS
with
SIMULTANEOUS READINGS.

THE
SIXTH
BOOK
OF
THE
HISTORY
OF
THE
CITY
OF
LONDON
BY
JOHN STOW

CARDS TAKEN SIMULTANEOUSLY:

INTERVAL =2 MINUTES

M.E.P.

I.H.P.

No.	Time	H.P.		L.P.		H.P.		L.P.		Total I.H.P.
		H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	
1-1	9-12	21.0	28.6	6.6	6.6	14.56	17.35	10.52	10.52	52.95
-2	-14	28.3	29.3	6.6	6.9	17.87	18.01	10.65	11.06	57.59
-3	-16	26.6	29.3	6.6	6.0	16.64	17.73	10.52	9.46	54.35
-4	-18	28.3	29.3	6.6	7.3	17.81	17.81	10.53	11.68	57.83
-5	-20	28.3	30.0	7.3	7.6	18.04	18.42	11.70	10.60	58.76
2-1	-22	31.6	29.6	8.2	6.6	19.54	18.74	13.24	10.72	62.24
-2	-24	30.3	26.6	6.9	7.3	18.78	16.97	11.61	11.82	59.18
-3	-26	28.6	26.0	8.6	6.4	17.60	16.46	13.82	10.21	58.09
-4	-28	30.3	27.6	6.9	7.2	18.62	17.65	11.04	11.49	58.80
-5	-30	30.0	30.6	6.6	6.9	18.42	19.57	10.60	11.06	59.65
3-1	-32	29.0	29.6	7.2	6.3	18.04	18.96	11.66	9.91	58.57
-2	-34	28.3	28.0	6.7	6.3	17.26	17.91	10.75	9.91	55.83
-3	-36	29.0	27.3	7.1	6.7	17.62	17.45	11.40	10.75	57.22
-4	-38	29.3	28.6	7.2	6.7	18.09	18.39	11.66	10.75	58.89
-5	-40	30.7	30.0	7.1	6.4	18.93	19.20	12.05	10.36	60.54
4-1	-42	29.4	28.3	6.4	7.2	18.43	18.10	10.37	12.88	59.78
-2	-44	27.0	28.3	6.3	7.0	17.45	17.75	10.11	13.06	58.37
-3	-46	27.0	30.0	6.7	7.0	17.45	18.84	10.75	11.17	58.21
-4	-48	29.4	30.0	6.4	6.0	18.43	19.00	10.37	12.14	59.94
-5	-50	29.4	28.3	6.7	6.0	18.43	17.90	10.75	12.39	59.47
5-1	-52	29.51	31.11	6.7	7.3	18.64	17.82	11.62	11.76	59.84
-2	-54	29.51	30.5	7.3	6.5	18.29	16.58	12.65	11.67	59.19
-3	-56	27.8	30.5	7.3	6.9	17.26	16.89	12.98	11.67	58.72
-4	-58	27.8	30.5	6.7	7.3	17.45	16.83	11.66	11.63	57.57
-5	10-00	29.5	31.1	7.3	6.7	18.50	17.96	12.90	11.45	60.81

M.F.P.						I.H.P.				
		H.P.		L.P.		H.P.		L.P.		Total
No.	Time	H.F.	C.F.	H.F.	C.F.	H.F.	C.F.	H.F.	C.F.	I.H.P.
6-1	10-02	26.5	28.3	7.2	6.5	18.69	17.96	12.57	10.66	59.88
-2	-04	25.0	27.7	7.0	7.2	17.32	17.40	12.32	10.66	57.70
-3	-06	25.3	28.3	6.7	7.2	17.57	17.83	11.68	10.66	57.74
-4	-08	29.0	30.0	6.7	6.5	17.68	19.04	11.62	9.54	57.88
-5	-10	29.0	26.7	7.3	7.2	17.82	16.81	12.83	11.70	59.16
7-1	-12	29.8	28.2	7.9	7.1	18.36	16.85	12.60	11.29	59.10
-2	-14	29.9	28.6	8.8	7.4	18.64	16.62	14.16	11.79	61.21
-3	-16	33.8	27.0	7.3	6.7	18.92	17.07	11.65	10.63	58.27
-4	-18	28.4	26.0	10.0	6.7	17.20	18.08	15.87	10.63	61.78
-5	-20	28.3	26.7	10.5	7.1	17.14	18.41	16.70	11.29	63.54
8-1	-22	32.3	29.0	9.3	6.7	19.77	16.85	12.60	10.57	59.59
-2	-24	31.6	27.6	9.1	5.5	19.58	17.64	15.82	8.46	61.50
-3	-26	33.3	27.6	9.8	6.0	20.38	16.85	17.32	9.51	64.06
-4	-28	32.6	28.0	9.3	6.0	19.94	17.76	16.00	9.72	63.42
-5	-30	33.0	27.6	8.9	5.3	20.20	18.32	12.07	8.36	58.95
9-1	-32	29.7	29.7	7.7	7.3	18.22	18.74	12.15	11.05	60.16
-2	-34	31.7	29.1	7.7	7.7	19.42	18.32	12.12	12.32	62.18
-3	-36	31.7	29.7	6.5	8.0	19.12	18.74	11.00	12.56	61.42
-4	-38	32.4	29.7	6.5	8.0	19.58	18.74	11.04	12.64	62.00
-5	-40	32.4	29.7	7.3	7.6	19.73	18.74	12.04	11.94	62.45
10-1	-42	31.0	26.6	6.6	7.8	19.78	16.59	10.40	8.83	55.60
-2	-44	30.1	28.6	6.4	7.8	18.51	17.84	10.40	8.83	55.58
-3	-46	29.7	30.0	7.2	7.2	18.14	18.84	11.60	8.84	57.42
-4	-48	31.0	30.3	7.3	6.7	19.78	20.59	11.70	8.83	60.90
-5	-50	27.1	29.3	7.1	6.6	16.60	18.48	11.30	8.42	54.80
11-1	-52	31.4	28.3	7.2	7.9	18.85	19.77	11.44	12.43	62.49

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Index	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	18.0	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	22.0	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	23.0	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.8	31.9	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7	32.8	32.9	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7	37.8	37.9	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8	38.9	39.0	39.1	39.2	39.3	39.4	39.5	39.6	39.7	39.8	39.9	40.0	40.1	40.2	40.3	40.4	40.5	40.6	40.7	40.8	40.9	41.0	41.1	41.2	41.3	41.4	41.5	41.6	41.7	41.8	41.9	42.0	42.1	42.2	42.3	42.4	42.5	42.6	42.7	42.8	42.9	43.0	43.1	43.2	43.3	43.4	43.5	43.6	43.7	43.8	43.9	44.0	44.1	44.2	44.3	44.4	44.5	44.6	44.7	44.8	44.9	45.0	45.1	45.2	45.3	45.4	45.5	45.6	45.7	45.8	45.9	46.0	46.1	46.2	46.3	46.4	46.5	46.6	46.7	46.8	46.9	47.0	47.1	47.2	47.3	47.4	47.5	47.6	47.7	47.8	47.9	48.0	48.1	48.2	48.3	48.4	48.5	48.6	48.7	48.8	48.9	49.0	49.1	49.2	49.3	49.4	49.5	49.6	49.7	49.8	49.9	50.0	50.1	50.2	50.3	50.4	50.5	50.6	50.7	50.8	50.9	51.0	51.1	51.2	51.3	51.4	51.5	51.6	51.7	51.8	51.9	52.0	52.1	52.2	52.3	52.4	52.5	52.6	52.7	52.8	52.9	53.0	53.1	53.2	53.3	53.4	53.5	53.6	53.7	53.8	53.9	54.0	54.1	54.2	54.3	54.4	54.5	54.6	54.7	54.8	54.9	55.0	55.1	55.2	55.3	55.4	55.5	55.6	55.7	55.8	55.9	56.0	56.1	56.2	56.3	56.4	56.5	56.6	56.7	56.8	56.9	57.0	57.1	57.2	57.3	57.4	57.5	57.6	57.7	57.8	57.9	58.0	58.1	58.2	58.3	58.4	58.5	58.6	58.7	58.8	58.9	59.0	59.1	59.2	59.3	59.4	59.5	59.6	59.7	59.8	59.9	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0	62.1	62.2	62.3	62.4	62.5	62.6	62.7	62.8	62.9	63.0	63.1	63.2	63.3	63.4	63.5	63.6	63.7	63.8	63.9	64.0	64.1	64.2	64.3	64.4	64.5	64.6	64.7	64.8	64.9	65.0	65.1	65.2	65.3	65.4	65.5	65.6	65.7	65.8	65.9	66.0	66.1	66.2	66.3	66.4	66.5	66.6	66.7	66.8	66.9	67.0	67.1	67.2	67.3	67.4	67.5	67.6	67.7	67.8	67.9	68.0	68.1	68.2	68.3	68.4	68.5	68.6	68.7	68.8	68.9	69.0	69.1	69.2	69.3	69.4	69.5	69.6	69.7	69.8	69.9	70.0	70.1	70.2	70.3	70.4	70.5	70.6	70.7	70.8	70.9	71.0	71.1	71.2	71.3	71.4	71.5	71.6	71.7	71.8	71.9	72.0	72.1	72.2	72.3	72.4	72.5	72.6	72.7	72.8	72.9	73.0	73.1	73.2	73.3	73.4	73.5	73.6	73.7	73.8	73.9	74.0	74.1	74.2	74.3	74.4	74.5	74.6	74.7	74.8	74.9	75.0	75.1	75.2	75.3	75.4	75.5	75.6	75.7	75.8	75.9	76.0	76.1	76.2	76.3	76.4	76.5	76.6	76.7	76.8	76.9	77.0	77.1	77.2	77.3	77.4	77.5	77.6	77.7	77.8	77.9	78.0	78.1	78.2	78.3	78.4	78.5	78.6	78.7	78.8	78.9	79.0	79.1	79.2	79.3	79.4	79.5	79.6	79.7	79.8	79.9	80.0	80.1	80.2	80.3	80.4	80.5	80.6	80.7	80.8	80.9	81.0	81.1	81.2	81.3	81.4	81.5	81.6	81.7	81.8	81.9	82.0	82.1	82.2	82.3	82.4	82.5	82.6	82.7	82.8	82.9	83.0	83.1	83.2	83.3	83.4	83.5	83.6	83.7	83.8	83.9	84.0	84.1	84.2	84.3	84.4	84.5	84.6	84.7	84.8	84.9	85.0	85.1	85.2	85.3	85.4	85.5	85.6	85.7	85.8	85.9	86.0	86.1	86.2	86.3	86.4	86.5	86.6	86.7	86.8	86.9	87.0	87.1	87.2	87.3	87.4	87.5	87.6	87.7	87.8	87.9	88.0	88.1	88.2	88.3	88.4	88.5	88.6	88.7	88.8	88.9	89.0	89.1	89.2	89.3	89.4	89.5	89.6	89.7	89.8	89.9	90.0	90.1	90.2	90.3	90.4	90.5	90.6	90.7	90.8	90.9	91.0	91.1	91.2	91.3	91.4	91.5	91.6	91.7	91.8	91.9	92.0	92.1	92.2	92.3	92.4	92.5	92.6	92.7	92.8	92.9	93.0	93.1	93.2	93.3	93.4	93.5	93.6	93.7	93.8	93.9	94.0	94.1	94.2	94.3	94.4	94.5	94.6	94.7	94.8	94.9	95.0	95.1	95.2	95.3	95.4	95.5	95.6	95.7	95.8	95.9	96.0	96.1	96.2	96.3	96.4	96.5	96.6	96.7	96.8	96.9	97.0	97.1	97.2	97.3	97.4	97.5	97.6	97.7	97.8	97.9	98.0	98.1	98.2	98.3	98.4	98.5	98.6	98.7	98.8	98.9	99.0	99.1	99.2	99.3	99.4	99.5	99.6	99.7	99.8	99.9	100.0
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M.E.P.						I.H.P.				
		H.P.		L.P.		H.P.		L.P.		Total
No.	Time	H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	I.H.P.
11-2	10-54	28.1	27.6	7.3	7.2	17.00	17.26	11.64	11.49	57.39
-3	-56	29.4	28.6	7.5	6.7	17.79	17.84	11.80	10.62	58.05
-4	-58	29.4	28.3	6.8	6.7	17.79	18.64	11.02	10.55	58.00
-5	11-00	30.9	28.3	6.8	8.0	18.91	19.85	10.85	12.76	62.37
12-1	-02	28.8	27.3	6.7	7.7	16.59	17.22	10.00	12.32	56.13
-2	-04	27.1	27.3	7.1	7.5	16.63	17.88	11.30	11.89	57.70
-3	-06	27.5	26.6	6.5	7.3	16.85	16.82	10.30	11.69	55.66
-4	-08	29.4	26.6	6.2	7.3	18.00	16.78	9.90	11.69	56.37
-5	-10	29.4	27.6	6.6	7.2	17.79	17.41	10.30	11.37	56.87
13-1	-12	No card taken.								
-2	-14	30.0	26.6	6.1	6.7	18.15	16.59	9.80	10.62	55.16
-3	-16	28.7	26.0	6.0	6.4	17.48	16.32	9.60	10.16	53.56
-4	-18	33.3	27.0	6.3	6.9	20.40	17.03	10.00	9.98	57.41
-5	-20	34.7	26.6	8.0	6.4	22.38	16.94	13.90	10.16	63.38
14-1	-22	27.1	23.3	6.6	7.2	16.73	14.79	10.20	11.57	53.09
-2	-24	27.1	22.0	6.7	6.6	16.65	13.92	10.60	11.59	52.76
-3	-26	25.4	24.0	6.1	5.7	15.68	15.24	10.00	9.14	50.06
-4	-28	25.8	22.0	6.1	5.9	15.90	14.03	9.90	9.44	49.27
-5	-30	No card taken.								
15-1	-32	25.3	26.6	5.9	7.4	15.43	16.70	9.50	11.86	53.49
-2	-34	25.0	27.8	5.9	7.2	15.45	20.43	9.50	11.52	56.90
-3	-36	25.0	26.2	5.9	7.0	15.45	19.25	9.50	11.20	55.40
-4	-38	25.3	27.4	7.3	7.4	15.48	17.28	11.50	11.70	55.96
-5	-40	25.3	26.6	5.9	7.2	15.43	16.70	9.40	11.86	53.39
16-1	-42	23.2	26.6	5.9	6.5	14.07	16.78	9.40	10.41	50.66
-2	-44	23.2	26.0	5.3	6.5	14.70	16.51	8.40	10.49	50.10

[illegible]

[illegible]

[illegible]

		M.F.P.				I.H.P.				
		H.P.		L.P.		H.P.		L.P.		Total
No.	Time	H.F.	C.F.	H.F.	C.F.	H.F.	C.F.	H.F.	C.F.	I.H.P.
21-4	12-38	No cards taken.								
-5	-40	11.7	11.3	.7	1.7	7.36	7.05	1.13	2.90	18.44
22-1	-42	11.7	12.3	.8	1.7	7.15	7.92	1.35	3.09	19.51
-2	-44	11.3	12.3	.8	1.7	6.90	7.84	1.35	2.79	18.88
-3	-46	10.4	11.6	.8	1.7	6.57	7.23	1.37	2.84	18.01
-4	-48	10.9	12.3	.8	1.7	6.74	7.84	1.35	2.79	18.12
-5	-50	No cards taken.								
23-1	-52	8.8	13.6	.6	2.0	5.46	8.63	1.14	3.20	18.43
-2	-54	10.1	13.6	.6	2.0	6.27	8.63	1.14	3.20	19.24
-3	-56	Cards incomplete.								
-4	-58									
-5	1-00									
24-1	-02	13.1	16.6	.8	2.4	8.09	10.59	1.22	3.87	23.77
-2	-04	13.1	16.6	.8	2.5	8.06	10.54	1.28	4.07	23.95
-3	-08	16.4	17.0	.9	2.9	10.00	10.72	1.41	4.67	26.80
-4	-08	22.9	20.6	1.6	5.5	14.10	16.89	2.62	8.77	42.38
-5	-10	28.1	26.6	2.2	7.2	17.25	16.84	3.45	11.41	48.95
25-1	-12	30.0	27.2	10.0	7.7	19.00	17.40	15.96	12.30	64.66
-2	-14	30.0	28.2	10.3	8.1	19.00	17.80	16.43	12.98	66.21
-3	-16	29.0	27.2	7.2	7.2	18.35	17.05	11.58	11.50	58.48
-4	-18	30.6	27.2	7.2	7.0	19.35	17.40	11.58	11.20	59.53
-5	-20	30.0	27.2	7.2	6.9	18.70	16.90	11.40	10.90	57.90
26-1	-22	31.7	28.4	6.5	6.7	19.20	17.75	10.38	10.49	57.82
-2	-24	30.0	29.4	6.5	6.7	18.50	18.35	10.40	10.32	57.57
-3	-26	29.7	27.4	6.5	6.7	17.95	17.15	10.30	10.62	56.02
-4	-28	30.0	28.4	6.5	6.7	18.00	17.55	10.20	10.22	55.97

[illegible]

M.E.P.

I.H.P.

No.	Time	H.P.		L.P.		H.P.		L.P.		Total
		H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	
26-5	1-30	29.7	29.0	6.5	6.7	17.95	18.05	10.30	10.62	56.92
27-1	-32	28.3	29.8	7.2	7.1	17.50	18.60	11.12	11.05	58.27
-2	-34	29.3	27.2	7.6	7.1	17.90	17.05	12.10	11.21	58.26
-3	-36	28.9	28.1	7.3	7.1	17.70	17.80	11.75	11.23	58.48
-4	-38	29.3	26.2	7.3	7.1	17.90	16.40	11.70	11.20	57.20
-5	-40	29.0	26.2	7.5	7.4	17.75	16.60	11.95	11.05	57.35
28-1	-42	29.1	27.5	7.1	6.8	17.95	17.60	11.40	10.90	57.85
-2	-44	30.1	27.3	7.5	7.0	18.30	17.20	12.30	11.10	58.90
-3	-46	28.4	27.3	7.5	6.9	17.60	17.40	12.40	11.10	58.50
-4	-48	28.4	28.0	7.5	6.9	17.30	17.60	12.30	10.95	58.15
-5	-50	29.4	28.0	7.3	7.2	17.95	17.60	11.22	11.25	58.02
29-1	-52	31.6	27.0	7.7	7.3	19.25	16.60	12.20	11.60	59.65
-2	-54	27.2	26.6	7.4	7.2	17.20	16.40	11.75	11.40	56.75
-3	-56	30.6	28.3	7.0	7.7	18.75	17.90	11.20	10.80	58.65
-4	-58	31.6	29.0	7.3	7.8	19.05	18.00	11.50	10.65	59.20
-5	2-00	31.6	27.6	7.4	7.2	19.05	17.30	11.62	11.10	59.07
30-1	-02	30.4	28.5	7.4	7.4	18.40	17.80	11.60	11.62	59.42
-2	-04	30.4	29.2	7.2	6.8	18.50	18.20	11.44	10.70	58.84
-3	-06	29.7	29.9	7.2	6.6	18.00	18.70	11.44	10.35	58.49
-4	-08	29.7	29.2	7.2	6.7	18.10	18.30	11.48	10.70	58.58
-5	-10	29.7	27.6	7.2	6.7	18.00	18.80	11.44	10.50	58.74
31-1	-12	28.2	30.1	6.5	7.2	17.30	19.10	10.30	10.70	57.40
-2	-14	28.5	29.1	6.6	6.6	17.30	18.10	10.20	9.90	55.50
-3	-16	27.9	27.2	6.5	6.6	17.10	17.20	10.30	10.70	55.30
-4	-18	28.9	27.5	6.7	6.8	17.60	17.40	10.40	10.90	56.30
-5	-20	28.5	27.5	6.5	6.6	17.40	17.40	10.20	10.45	55.45

M.E.P.

I.H.P.

No.	Time	H.P.		L.P.		H.P.		L.P.		Total
		H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	
32-1	2-22	32.7	29.6	7.4	6.6	19.76	18.47	11.66	10.60	60.49
-2	-24	26.1	26.6	7.2	6.8	16.93	16.70	11.40	10.64	55.67
-3	-26	27.5	27.6	7.0	6.6	16.99	17.70	11.30	10.64	56.63
-4	-28	28.8	28.6	7.2	6.6	17.74	18.15	11.50	10.55	57.94
-5	-30	27.1	25.6	6.6	6.8	16.41	15.97	11.45	10.70	54.53
33-1	-32	28.7	28.6	7.0	6.4	17.34	17.84	11.50	10.15	56.83
-2	-34	28.7	28.3	7.2	6.3	17.53	17.85	11.50	10.00	56.88
-3	-36	30.0	26.6	7.7	7.5	18.57	16.97	12.40	12.00	59.94
-4	-38	28.3	25.0	7.9	6.9	17.39	15.82	12.50	11.10	56.81
-5	-40	28.3	26.6	8.0	7.5	17.32	16.80	12.70	11.90	58.72
34-1	-42	29.4	30.0	7.6	7.9	18.18	19.14	11.90	12.65	61.87
-2	-44	30.1	28.6	7.6	7.9	18.45	17.76	11.90	12.35	60.46
-3	-46	29.4	28.0	7.2	8.3	17.65	17.36	11.40	12.97	59.38
-4	-48	29.4	30.0	7.6	7.5	17.77	18.72	12.00	11.70	60.19
-5	-50	29.4	29.6	7.4	8.1	17.77	18.47	11.60	12.80	60.64
35-1	-52	36.7	31.3	9.0	9.1	22.18	19.53	14.20	14.20	70.11
-2	-54	35.0	33.3	8.9	8.7	21.16	20.77	14.00	13.60	69.53
-3	-56	35.0	32.3	8.5	8.5	21.35	20.28	17.70	13.60	68.93
-4	-58	36.7	34.0	9.2	9.3	22.43	21.47	14.70	14.80	73.40
-5	3-00	35.3	35.3	9.2	9.2	21.61	22.34	14.70	14.50	73.15
36-1	-02	36.7	33.0	9.8	9.6	20.72	22.38	15.60	15.26	73.96
-2	-04	33.4	33.0	9.6	9.5	20.65	20.21	15.20	14.96	71.02
-3	-06	34.4	33.0	9.3	9.7	20.65	20.81	14.70	15.42	71.58
-4	-08	32.7	29.0	8.9	9.3	17.99	19.72	14.10	14.70	66.51
-5	-10	32.7	31.0	8.9	9.3	19.40	19.72	14.20	14.78	68.10
37-1	-12	35.8	32.0	10.2	8.6	21.66	20.13	16.32	13.62	71.73

[illegible]

M.E.P.

I.H.P.

No.	Time	H.P.		L.P.		H.P.		L.P.		Total
		H.E.	C.E.	H.E.	G.M.	H.E.	C.E.	H.E.	C.E.	
37-2	3-14	34.8	31.0	9.8	8.7	21.05	19.40	15.61	13.80	69.86
-3	-16	34.5	31.0	9.8	8.3	21.11	19.56	15.63	13.20	69.50
-4	-18	34.8	32.0	9.6	8.7	21.54	20.42	15.48	14.20	71.64
-5	-20	36.1	33.0	9.4	8.7	21.10	20.79	15.00	14.82	71.71
38-1	-22	37.8	33.4	12.4	11.2	23.13	21.10	19.80	17.86	81.89
-2	-24	36.1	36.8	12.1	10.4	22.16	23.27	19.30	16.62	81.35
-3	-26	41.5	40.5	12.4	10.4	25.11	25.23	19.68	16.49	86.51
-4	-28	41.5	36.7	11.7	10.4	25.61	23.30	18.73	16.71	84.35
-5	-30	41.5	28.5	10.9	11.2	25.11	24.05	17.27	18.80	84.23
39-1	-32	43.4	40.0	10.9	11.2	25.43	24.76	17.05	17.50	84.74
-2	-34	41.0	39.3	11.1	11.6	24.91	24.62	17.60	18.38	85.51
-3	-36	40.7	38.7	11.7	11.6	24.38	22.71	18.23	18.05	83.37
-4	-38	41.0	38.3	11.7	10.8	24.83	23.89	18.43	17.02	84.17
-5	-40	41.3	38.0	11.7	10.0	24.92	23.60	18.40	15.71	82.63
40-1	-42	41.0	39.3	11.6	11.6	24.72	23.99	18.05	17.90	84.66
-2	-44	42.0	40.0	11.1	12.5	24.95	24.76	18.60	19.68	87.99
-3	-46	41.0	40.3	10.4	10.1	24.10	25.63	18.08	17.80	85.61
-4	-48	41.0	40.0	10.8	11.6	24.80	24.64	16.91	18.05	84.40
-5	-50	39.0	43.0	11.6	12.0	23.36	26.23	17.98	18.62	86.19
41-1	-52	42.0	44.0	11.6	11.2	25.49	27.46	18.26	17.53	88.74
-2	-54	44.0	44.0	11.6	11.6	26.93	27.52	18.48	18.48	91.41
-3	-56	41.0	40.0	11.6	12.4	24.88	24.96	18.30	19.68	87.82
-4	-58	42.0	44.0	11.6	12.4	25.03	27.02	18.00	19.30	89.35
-5	4-00	42.0	46.0	12.4	11.2	25.40	28.66	19.35	17.70	91.11
42-1	-02	44.0	42.0	11.6	11.9	26.53	26.10	18.20	18.50	89.33
-2	-04	45.0	41.0	12.4	12.6	27.22	25.70	19.60	19.70	92.22

[illegible]

M.E.P.

I.H.P.

No.	Time	H.P.		L.P.		H.P.		L.P.		Total I.H.P.
		H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	H.E.	C.E.	
42-3	4-06	45.0	43.0	12.8	12.6	27.23	26.90	20.40	19.80	94.33
-4	-08	44.0	44.0	Inc.	11.9	26.72	27.40	Inc.	18.70	
-5	-10	45.0	43.0	Cards	11.6	26.45	26.80	Cards	18.40	
43-1	-12	50.3	45.7	13.1	14.6	30.13	28.30	20.05	22.75	101.23
-2	-14	49.8	37.8	14.4	14.6	29.93	23.40	22.60	22.90	98.83
-3	-16	50.9	50.1	15.3	15.3	30.69	31.10	24.00	24.02	109.81
-4	-18	50.9	52.8	15.1	16.0	30.79	32.20	23.80	25.05	111.84
-5	-20	51.2	50.1	15.7	16.0	31.08	31.30	24.85	25.08	112.31
44-1	-22	53.0	50.6	15.1	15.6	31.71	31.50	23.37	24.30	110.88
-2	-24	50.0	50.3	15.1	15.6	29.95	31.30	23.37	24.30	108.92
-3	-26	49.4	49.3	15.1	14.8	28.72	30.40	21.10	22.30	102.52
-4	-28	48.7	48.9	13.1	14.4	28.12	30.00	17.08	18.80	94.00
-5	-30	40.6	39.0	11.8	10.0	23.10	23.90	11.80	11.00	69.80
45-1	-32	49.0	45.9	12.6	13.1	26.88	26.39	18.00	18.70	89.97
-2	-34	47.0	45.3	12.9	13.1	27.26	26.94	19.50	19.80	93.50
-3	-36	46.0	43.6	12.6	13.1	26.59	25.89	18.90	19.60	90.98
-4	-38	46.0	43.6	12.6	13.1	26.77	26.16	19.05	19.90	91.88
-5	-40	46.0	43.6	12.6	13.1	27.60	26.06	19.80	20.05	93.51

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4 M GROSS POLINE

ENGINE.

UNIV OF ILL.

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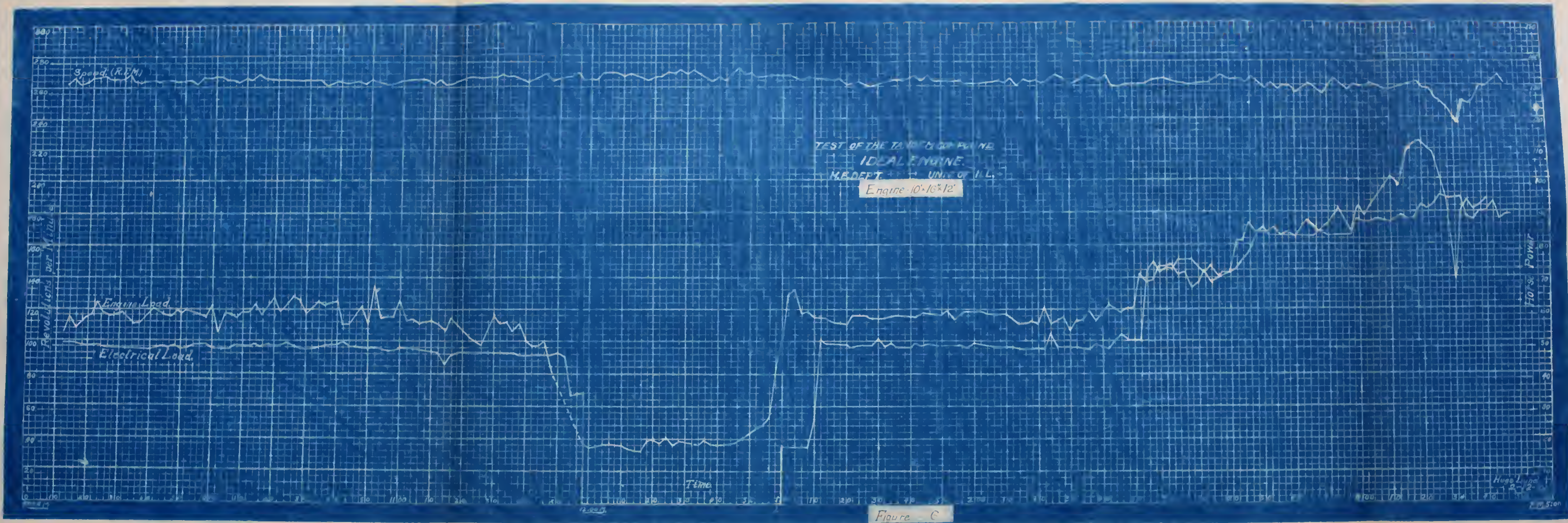


Figure C

TABLE V.
INDICATED HORSE POWER
for
FOUR MINUTE INTERVALS
with
SIMULTANEOUS READINGS.

THE
NEW YORK
LIBRARY
ASTOR LENOX
TILDEN FOUNDATION
1901

CARDS TAKEN SIMULTANEOUSLY:

INTERVAL= 4 MINUTES.

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56	17.35	10.52	10.52	52.95
-16	16.64	17.73	10.52	9.46	54.35
-20	18.04	18.42	11.70	10.60	58.76
-24	18.78	16.97	11.61	11.82	59.18
-28	18.62	17.65	11.04	11.49	58.80
-32	18.04	18.96	11.66	9.91	58.57
-36	17.62	17.45	11.40	10.75	57.22
-40	18.93	19.20	12.05	10.36	60.54
-44	17.45	17.75	10.11	13.06	58.37
-48	18.43	19.00	10.37	12.14	59.94
-52	18.64	17.82	11.62	11.76	59.84
-56	17.26	16.89	12.90	11.67	58.72
10-00	18.50	17.96	12.90	11.45	60.81
-04	17.32	17.40	12.32	10.66	57.70
-08	17.68	19.04	11.62	9.54	57.88
-12	18.36	16.85	12.60	11.29	59.10
-16	18.92	17.07	11.65	10.63	58.27
-20	17.14	18.41	16.70	11.29	63.54
-24	19.58	17.64	15.82	8.46	61.50
-28	19.94	17.76	16.00	9.72	63.42
-32	18.22	18.74	12.15	11.05	60.76
-36	19.12	18.74	11.00	12.56	61.42
-40	19.73	18.74	12.04	11.94	62.45
-44	18.51	17.84	10.40	8.83	55.58
-48	19.78	20.59	11.70	8.83	60.90

TABLE 1

1947	1948	1949	1950	1951	1952
1.00	1.00	1.00	1.00	1.00	1.00
1.01	1.02	1.03	1.04	1.05	1.06
1.02	1.04	1.06	1.08	1.10	1.12
1.03	1.06	1.09	1.12	1.15	1.18
1.04	1.08	1.12	1.16	1.20	1.24
1.05	1.10	1.15	1.20	1.25	1.30
1.06	1.12	1.18	1.24	1.30	1.36
1.07	1.14	1.21	1.28	1.35	1.42
1.08	1.16	1.24	1.32	1.40	1.48
1.09	1.18	1.27	1.36	1.45	1.54
1.10	1.20	1.30	1.40	1.50	1.60
1.11	1.22	1.33	1.44	1.55	1.66
1.12	1.24	1.36	1.48	1.60	1.72
1.13	1.26	1.39	1.52	1.65	1.78
1.14	1.28	1.42	1.56	1.70	1.84
1.15	1.30	1.45	1.60	1.75	1.90
1.16	1.32	1.48	1.64	1.80	1.96
1.17	1.34	1.51	1.68	1.85	2.02
1.18	1.36	1.54	1.72	1.90	2.08
1.19	1.38	1.57	1.76	1.95	2.14
1.20	1.40	1.60	1.80	2.00	2.20
1.21	1.42	1.63	1.84	2.05	2.26
1.22	1.44	1.66	1.88	2.10	2.32
1.23	1.46	1.69	1.92	2.15	2.38
1.24	1.48	1.72	1.96	2.20	2.44
1.25	1.50	1.75	2.00	2.25	2.50
1.26	1.52	1.78	2.04	2.30	2.56
1.27	1.54	1.81	2.08	2.35	2.62
1.28	1.56	1.84	2.12	2.40	2.68
1.29	1.58	1.87	2.16	2.45	2.74
1.30	1.60	1.90	2.20	2.50	2.80
1.31	1.62	1.93	2.24	2.55	2.86
1.32	1.64	1.96	2.28	2.60	2.92
1.33	1.66	1.99	2.32	2.65	2.98
1.34	1.68	2.02	2.36	2.70	3.04
1.35	1.70	2.05	2.40	2.75	3.10
1.36	1.72	2.08	2.44	2.80	3.16
1.37	1.74	2.11	2.48	2.85	3.22
1.38	1.76	2.14	2.52	2.90	3.28
1.39	1.78	2.17	2.56	2.95	3.34
1.40	1.80	2.20	2.60	3.00	3.40

I.H.P.

H.P.

L.P.

Time	H.E.	C.E.	H.E.	C.E.	I.H.P.
10-52	18.85	19.77	11.44	12.43	62.49
-56	17.79	17.84	11.80	10.62	58.05
11-00	18.91	19.85	10.85	12.76	62.37
-04	16.63	17.88	11.30	11.89	57.70
-08	18.00	16.78	9.90	11.69	56.37
-12			No card.		
-14	18.15	16.59	9.80	10.62	55.16
-16	17.48	16.32	9.60	10.16	53.56
-20	22.38	16.94	13.90	10.16	63.38
-24	16.65	13.92	10.60	11.59	52.76
-28	15.90	14.03	9.90	9.44	49.27
-32	15.43	16.70	9.50	11.86	53.49
-36	15.45	19.25	9.50	11.20	55.40
-40	15.43	16.70	9.40	11.86	53.39
-44	14.70	16.51	8.40	10.49	50.10
-48	15.30	15.38	8.30	9.53	48.51
-52	No cards taken				
-56	Indicator string broken.				
12-00					
-02	9.32	5.88	.99	2.76	18.95
-04	8.13	5.77	1.00	8.79	17.69
-08	7.40	7.44	1.00	2.79	18.63
-12	7.41	6.40	.84	2.59	17.24
-16	7.06	6.74	.84	2.36	17.00
-20	6.42	6.38	.84	2.58	16.22
-24	6.50	9.63	.85	3.36	20.34
-28	7.00	9.39	.86	3.37	20.62

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
12-32	7.62	8.11	1.15	2.81	19.69
-36		No card taken.			
-40	7.36	7.05	1.13	2.90	18.44
-44	6.90	7.84	1.35	2.79	18.88
-48	6.74	7.84	1.35	2.79	18.72
-52	5.46	8.63	1.14	3.20	18.43
-56		Card incomplete.			
1-00					
-02	8.09	10.59	1.22	3.87	23.77
-04	8.06	10.54	1.28	4.07	23.95
-08	14.10	16.89	2.62	8.77	42.38
-12	19.00	17.40	15.96	12.30	64.66
-16	18.35	17.05	11.58	11.50	58.48
-20	18.70	16.90	11.40	10.90	57.90
-24	18.50	18.35	10.40	10.32	57.57
-28	18.00	17.55	10.20	10.22	55.97
-32	17.50	18.60	11.12	11.05	58.27
-36	17.70	17.80	11.75	11.23	58.48
-40	17.75	16.60	11.95	11.05	57.35
-44	18.30	17.20	12.30	11.10	58.90
-48	17.30	17.60	12.30	10.95	58.15
-52	19.25	16.60	12.20	11.60	59.65
-56	18.75	17.90	11.20	10.80	58.65
2-00	19.05	17.30	11.62	11.10	59.07
-04	18.50	18.20	11.44	10.70	58.84
-08	18.10	18.30	11.48	10.50	58.58

Table 1

Year	1950	1951	1952	1953	1954
1950	10.0	11.0	12.0	13.0	14.0
1951					15.0
1952	16.0	17.0	18.0	19.0	20.0
1953	21.0	22.0	23.0	24.0	25.0
1954	26.0	27.0	28.0	29.0	30.0
1955					31.0
1956	36.0	37.0	38.0	39.0	40.0
1957	41.0	42.0	43.0	44.0	45.0
1958	46.0	47.0	48.0	49.0	50.0
1959	51.0	52.0	53.0	54.0	55.0
1960	56.0	57.0	58.0	59.0	60.0
1961	61.0	62.0	63.0	64.0	65.0
1962	66.0	67.0	68.0	69.0	70.0
1963	71.0	72.0	73.0	74.0	75.0
1964	76.0	77.0	78.0	79.0	80.0
1965	81.0	82.0	83.0	84.0	85.0
1966	86.0	87.0	88.0	89.0	90.0
1967	91.0	92.0	93.0	94.0	95.0
1968	96.0	97.0	98.0	99.0	100.0
1969	101.0	102.0	103.0	104.0	105.0
1970	106.0	107.0	108.0	109.0	110.0
1971	111.0	112.0	113.0	114.0	115.0
1972	116.0	117.0	118.0	119.0	120.0
1973	121.0	122.0	123.0	124.0	125.0
1974	126.0	127.0	128.0	129.0	130.0
1975	131.0	132.0	133.0	134.0	135.0
1976	136.0	137.0	138.0	139.0	140.0
1977	141.0	142.0	143.0	144.0	145.0
1978	146.0	147.0	148.0	149.0	150.0
1979	151.0	152.0	153.0	154.0	155.0
1980	156.0	157.0	158.0	159.0	160.0
1981	161.0	162.0	163.0	164.0	165.0
1982	166.0	167.0	168.0	169.0	170.0
1983	171.0	172.0	173.0	174.0	175.0
1984	176.0	177.0	178.0	179.0	180.0
1985	181.0	182.0	183.0	184.0	185.0
1986	186.0	187.0	188.0	189.0	190.0
1987	191.0	192.0	193.0	194.0	195.0
1988	196.0	197.0	198.0	199.0	200.0
1989	201.0	202.0	203.0	204.0	205.0
1990	206.0	207.0	208.0	209.0	210.0
1991	211.0	212.0	213.0	214.0	215.0
1992	216.0	217.0	218.0	219.0	220.0
1993	221.0	222.0	223.0	224.0	225.0
1994	226.0	227.0	228.0	229.0	230.0
1995	231.0	232.0	233.0	234.0	235.0
1996	236.0	237.0	238.0	239.0	240.0
1997	241.0	242.0	243.0	244.0	245.0
1998	246.0	247.0	248.0	249.0	250.0
1999	251.0	252.0	253.0	254.0	255.0
2000	256.0	257.0	258.0	259.0	260.0
2001	261.0	262.0	263.0	264.0	265.0
2002	266.0	267.0	268.0	269.0	270.0
2003	271.0	272.0	273.0	274.0	275.0
2004	276.0	277.0	278.0	279.0	280.0
2005	281.0	282.0	283.0	284.0	285.0
2006	286.0	287.0	288.0	289.0	290.0
2007	291.0	292.0	293.0	294.0	295.0
2008	296.0	297.0	298.0	299.0	300.0
2009	301.0	302.0	303.0	304.0	305.0
2010	306.0	307.0	308.0	309.0	310.0
2011	311.0	312.0	313.0	314.0	315.0
2012	316.0	317.0	318.0	319.0	320.0
2013	321.0	322.0	323.0	324.0	325.0
2014	326.0	327.0	328.0	329.0	330.0
2015	331.0	332.0	333.0	334.0	335.0
2016	336.0	337.0	338.0	339.0	340.0
2017	341.0	342.0	343.0	344.0	345.0
2018	346.0	347.0	348.0	349.0	350.0
2019	351.0	352.0	353.0	354.0	355.0
2020	356.0	357.0	358.0	359.0	360.0
2021	361.0	362.0	363.0	364.0	365.0
2022	366.0	367.0	368.0	369.0	370.0
2023	371.0	372.0	373.0	374.0	375.0
2024	376.0	377.0	378.0	379.0	380.0
2025	381.0	382.0	383.0	384.0	385.0
2026	386.0	387.0	388.0	389.0	390.0
2027	391.0	392.0	393.0	394.0	395.0
2028	396.0	397.0	398.0	399.0	400.0
2029	401.0	402.0	403.0	404.0	405.0
2030	406.0	407.0	408.0	409.0	410.0
2031	411.0	412.0	413.0	414.0	415.0
2032	416.0	417.0	418.0	419.0	420.0
2033	421.0	422.0	423.0	424.0	425.0
2034	426.0	427.0	428.0	429.0	430.0
2035	431.0	432.0	433.0	434.0	435.0
2036	436.0	437.0	438.0	439.0	440.0
2037	441.0	442.0	443.0	444.0	445.0
2038	446.0	447.0	448.0	449.0	450.0
2039	451.0	452.0	453.0	454.0	455.0
2040	456.0	457.0	458.0	459.0	460.0
2041	461.0	462.0	463.0	464.0	465.0
2042	466.0	467.0	468.0	469.0	470.0
2043	471.0	472.0	473.0	474.0	475.0
2044	476.0	477.0	478.0	479.0	480.0
2045	481.0	482.0	483.0	484.0	485.0
2046	486.0	487.0	488.0	489.0	490.0
2047	491.0	492.0	493.0	494.0	495.0
2048	496.0	497.0	498.0	499.0	500.0
2049	501.0	502.0	503.0	504.0	505.0
2050	506.0	507.0	508.0	509.0	510.0
2051	511.0	512.0	513.0	514.0	515.0
2052	516.0	517.0	518.0	519.0	520.0
2053	521.0	522.0	523.0	524.0	525.0
2054	526.0	527.0	528.0	529.0	530.0
2055	531.0	532.0	533.0	534.0	535.0
2056	536.0	537.0	538.0	539.0	540.0
2057	541.0	542.0	543.0	544.0	545.0
2058	546.0	547.0	548.0	549.0	550.0
2059	551.0	552.0	553.0	554.0	555.0
2060	556.0	557.0	558.0	559.0	560.0
2061	561.0	562.0	563.0	564.0	565.0
2062	566.0	567.0	568.0	569.0	570.0
2063	571.0	572.0	573.0	574.0	575.0
2064	576.0	577.0	578.0	579.0	580.0
2065	581.0	582.0	583.0	584.0	585.0
2066	586.0	587.0	588.0	589.0	590.0
2067	591.0	592.0	593.0	594.0	595.0
2068	596.0	597.0	598.0	599.0	600.0
2069	601.0	602.0	603.0	604.0	605.0
2070	606.0	607.0	608.0	609.0	610.0
2071	611.0	612.0	613.0	614.0	615.0
2072	616.0	617.0	618.0	619.0	620.0
2073	621.0	622.0	623.0	624.0	625.0
2074	626.0	627.0	628.0	629.0	630.0
2075	631.0	632.0	633.0	634.0	635.0
2076	636.0	637.0	638.0	639.0	640.0
2077	641.0	642.0	643.0	644.0	645.0
2078	646.0	647.0	648.0	649.0	650.0
2079	651.0	652.0	653.0	654.0	655.0
2080	656.0	657.0	658.0	659.0	660.0
2081	661.0	662.0	663.0	664.0	665.0
2082	666.0	667.0	668.0	669.0	670.0
2083	671.0	672.0	673.0	674.0	675.0
2084	676.0	677.0	678.0	679.0	680.0
2085	681.0	682.0	683.0	684.0	685.0
2086	686.0	687.0	688.0	689.0	690.0
2087	691.0	692.0	693.0	694.0	695.0
2088	696.0	697.0	698.0	699.0	700.0
2089	701.0	702.0	703.0	704.0	705.0
2090	706.0	707.0	708.0	709.0	710.0
2091	711.0	712.0	713.0	714.0	715.0
2092	716.0	717.0	718.0	719.0	720.0
2093	721.0	722.0	723.0	724.0	725.0
2094	726.0	727.0	728.0	729.0	730.0
2095	731.0	732.0	733.0	734.0	735.0
2096	736.0	737.0	738.0	739.0	740.0
2097	741.0	742.0	743.0	744.0	745.0
2098	746.0	747.0	748.0	749.0	750.0
2099	751.0	752.0	753.0	754.0	755.0
2100	756.0	757.0	758.0	759.0	760.0

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
2-12	17.30	19.10	10.30	10.70	57.40
-16	17.10	17.20	10.30	10.70	55.30
-20	17.40	17.40	10.20	10.45	55.45
-24	16.93	16.70	11.40	10.64	55.67
-28	18.15	15.97	11.45	10.55	57.94
-32	17.34	17.84	11.50	10.15	56.83
-36	18.57	16.97	12.40	12.00	59.94
-40	17.32	16.80	12.70	11.90	58.72
-44	18.45	17.76	11.90	12.35	60.46
-48	17.77	18.72	12.00	11.70	60.19
-52	22.18	19.53	14.20	14.20	70.11
-56	21.35	20.28	13.70	13.60	68.93
3-00	21.61	22.34	14.70	14.50	73.15
-04	20.65	20.21	15.20	14.96	71.02
-08	17.99	19.72	14.10	14.70	66.51
-12	21.66	20.13	16.32	13.62	71.73
-16	21.11	19.56	15.63	13.20	69.50
-20	21.10	20.79	15.00	14.82	71.71
-24	22.16	23.27	19.30	16.62	81.35
-28	25.11	23.30	18.73	16.71	84.35
-32	25.43	24.76	17.05	17.50	84.74
-36	24.38	22.71	18.23	18.05	83.37
-40	24.92	23.60	18.40	15.71	82.63
-44	24.95	24.76	18.60	19.68	87.99
-48	24.80	24.64	16.91	18.05	84.40
-52	25.49	27.46	18.26	17.53	88.74

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
3-56	24.88	24.96	18.30	19.68	87.82
4-00	25.40	28.66	19.35	17.70	91.11
-04	27.22	25.70	19.60	19.70	92.22
-08	Incomplete Card.				
-12	30.13	28.30	20.05	22.75	101.23
-16	30.69	31.10	24.00	24.02	109.81
-20	31.08	31.30	24.85	25.08	112.31
-24	29.95	31.30	23.37	24.30	108.92
-28	28.12	30.00	17.08	18.80	94.00
-32	26.88	26.39	18.00	18.70	89.97
-36	26.59	25.89	18.90	19.60	90.98
-40	27.60	26.08	19.80	20.05	93.51

Year	1970	1971	1972	1973	1974
1970	100.0	100.0	100.0	100.0	100.0
1971	100.0	100.0	100.0	100.0	100.0
1972	100.0	100.0	100.0	100.0	100.0
1973	100.0	100.0	100.0	100.0	100.0
1974	100.0	100.0	100.0	100.0	100.0

TABLE VI.
INDICATED HORSE POWER
for
SIX MINUTE INTERVALS
with
SIMULTANEOUS READINGS.

.TV RUDAY

RECORD NUMBER 001234567

1-5

REASONING NUMBER 00

021W

.REASONING NUMBER 001234567

CARDS TAKEN SIMULTANEOUSLY.

INTERVAL = 6 MINUTES.

I.H.P.

	H.P.		L.P.		Total
Time	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56	17.35	10.52	10.52	52.95
-18	17.81	17.81	10.53	11.68	57.83
-24	18.78	16.97	11.61	11.82	59.18
-30	18.42	19.57	10.60	11.06	59.65
-36	17.62	17.45	11.40	10.75	57.22
-42	18.43	18.10	10.37	12.88	59.78
-48	18.43	19.00	10.37	12.14	59.94
-54	18.29	16.58	12.65	11.67	59.19
10-00	18.50	17.96	12.90	11.45	60.81
-06	17.57	17.83	11.68	10.66	57.74
-12	18.36	16.85	12.60	11.29	59.10
-18	17.20	18.88	15.87	10.63	61.78
-24	19.58	17.64	15.82	8.46	61.50
-30	20.20	18.32	12.07	8.36	58.95
-36	19.12	18.74	11.00	12.56	61.42
-42	19.78	16.59	10.40	8.83	55.60
-48	19.78	20.59	11.70	8.83	60.90
-54	17.00	17.26	11.64	11.49	57.39
11-00	18.91	19.85	10.85	12.76	62.37
-06	16.85	16.82	10.30	11.69	55.66
-12	No card taken.				
-14	18.15	16.59	9.80	10.62	55.16
-18	20.40	17.03	10.00	9.98	57.41
-24	16.65	13.92	10.60	11.59	52.76
-30	No card taken.				

Year	1990	1991	1992	1993	1994	1995
1990	1990	1991	1992	1993	1994	1995
1991	1991	1992	1993	1994	1995	1996
1992	1992	1993	1994	1995	1996	1997
1993	1993	1994	1995	1996	1997	1998
1994	1994	1995	1996	1997	1998	1999
1995	1995	1996	1997	1998	1999	2000
1996	1996	1997	1998	1999	2000	2001
1997	1997	1998	1999	2000	2001	2002
1998	1998	1999	2000	2001	2002	2003
1999	1999	2000	2001	2002	2003	2004
2000	2000	2001	2002	2003	2004	2005
2001	2001	2002	2003	2004	2005	2006
2002	2002	2003	2004	2005	2006	2007
2003	2003	2004	2005	2006	2007	2008
2004	2004	2005	2006	2007	2008	2009
2005	2005	2006	2007	2008	2009	2010
2006	2006	2007	2008	2009	2010	2011
2007	2007	2008	2009	2010	2011	2012
2008	2008	2009	2010	2011	2012	2013
2009	2009	2010	2011	2012	2013	2014
2010	2010	2011	2012	2013	2014	2015
2011	2011	2012	2013	2014	2015	2016
2012	2012	2013	2014	2015	2016	2017
2013	2013	2014	2015	2016	2017	2018
2014	2014	2015	2016	2017	2018	2019
2015	2015	2016	2017	2018	2019	2020
2016	2016	2017	2018	2019	2020	2021
2017	2017	2018	2019	2020	2021	2022
2018	2018	2019	2020	2021	2022	2023
2019	2019	2020	2021	2022	2023	2024
2020	2020	2021	2022	2023	2024	2025
2021	2021	2022	2023	2024	2025	2026
2022	2022	2023	2024	2025	2026	2027
2023	2023	2024	2025	2026	2027	2028
2024	2024	2025	2026	2027	2028	2029
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2032	2032	2033	2034	2035	2036	2037
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2034	2034	2035	2036	2037	2038	2039
2035	2035	2036	2037	2038	2039	2040
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2065	2065	2066	2067	2068	2069	2070
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2098	2098	2099	2100	2101	2102	2103
2099	2099	2100	2101	2102	2103	2104
2100	2100	2101	2102	2103	2104	2105
2101	2101	2102	2103	2104	2105	2106
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2104	2104	2105	2106	2107	2108	2109
2105	2105	2106	2107	2108	2109	2110
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2107	2107	2108	2109	2110	2111	2112
2108	2108	2109	2110	2111	2112	2113
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2110	2110	2111	2112	2113	2114	2115
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2144	2144	2145	2146	2147	2148	2149
2145	2145	2146	2147	2148	2149	2150
2146	2146	2147	2148	2149	2150	2151
2147	2147	2148	2149	2150	2151	2152
2148	2148	2149	2150	2151	2152	2153
2149	2149	2150	2151	2152	2153	2154
2150	2150	2151	2152	2153	2154	2155
2151	2151	2152	2153	2154	2155	2156
2152	2152	2153	2154	2155	2156	2157
2153	2153	2154	2155	2156	2157	2158
2154	2154	2155	2156	2157	2158	2159
2155	2155	2156	2157	2158	2159	2160
2156	2156	2157	2158	2159	2160	2161
2157	2157	2158	2159	2160	2161	2162
2158	2158	2159	2160	2161	2162	2163
2159	2159	2160	2161	2162	2163	2164
2160	2160	2161	2162	2163	2164	2165
2161	2161	2162	2163	2164	2165	2166
2162	2162	2163	2164	2165	2166	2167
2163	2163	2164	2165	2166	2167	2168
2164	2164	2165	2166	2167	2168	2169
2165	2165	2166	2167	2168	2169	2170
2166	2166	2167	2168	2169	2170	2171
2167	2167	2168	2169	2170	2171	2172
2168	2168	2169	2170	2171	2172	2173
2169	2169	2170	2171	2172	2173	2174
2170	2170	2171	2172	2173	2174	2175
2171	2171	2172	2173	2174	2175	2176
2172	2172	2173	2174	2175	2176	2177
2173	2173	2174	2175	2176	2177	

I.H.P.

	H.P.		L.P.		Total
Time	H.E.	C.E.	H.E.	C.E.	I.H.P.
11-32	15.43	16.70	9.50	11.86	53.49
-36	15.45	19.25	9.50	11.20	55.40
-42	14.07	16.78	9.40	10.41	50.66
-48	15.30	15.38	8.30	9.53	48.51
-56	No cards taken.				
12-00	Indicator string broken.				
-02	9.32	5.88	.99	2.76	18.95
-06	7.40	6.61	1.00	2.79	17.80
-12	7.41	6.40	.84	2.59	17.24
-18	6.18	7.31	.83	2.33	16.65
-24	6.50	9.63	.85	3.36	20.34
-30	7.26	6.76	.84	3.33	18.19
-36	No card taken.				
-40	7.36	7.05	1.13	2.90	18.44
-42	7.15	7.92	1.35	3.09	19.51
-48	6.74	7.84	1.35	2.79	18.72
-54	6.27	8.63	1.14	3.20	19.24
1-00	Card incomplete.				
-02	8.09	10.59	1.22	3.87	23.77
-06	10.00	10.72	1.41	4.67	26.80
-12	19.00	17.40	15.96	12.30	64.66
-18	19.35	17.40	11.58	11.20	59.53
-24	18.50	18.35	10.40	10.32	57.57
-30	17.95	18.05	10.30	10.62	56.92
-36	17.70	17.80	11.75	11.23	58.48
-42	17.95	17.60	11.40	10.90	57.85

[illegible]

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
1-48	17.30	17.60	12.30	10.95	58.15
-54	17.20	16.40	11.75	11.40	56.75
2-00	19.05	17.30	11.62	11.10	59.07
-06	18.00	18.70	11.44	10.35	58.49
-12	17.30	19.10	10.30	10.70	57.40
-18	17.60	17.40	10.40	10.90	56.30
-24	16.93	16.70	11.40	10.64	55.67
-30	16.4L	15.97	11.45	10.70	54.53
-36	18.57	16.97	12.40	12.00	59.94
-42	18.18	19.14	11.90	12.65	61.87
-48	17.77	18.72	12.00	11.70	60.19
-54	21.16	20.77	14.00	13.60	69.53
3-00	21.61	22.34	14.70	14.50	73.15
-06	20.65	20.81	14.70	15.42	71.58
-12	21.66	20.13	16.32	13.62	71.73
-18	21.54	20.42	15.48	14.20	71.64
-24	22.16	23.27	19.30	16.62	81.35
-30	25.11	24.05	17.27	17.80	84.23
-36	24.38	22.71	18.23	18.05	83.37
-42	24.72	23.99	18.05	17.90	84.66
-48	24.80	24.64	16.91	18.05	84.40
-54	26.93	27.52	18.48	18.48	91.41
4-00	25.40	28.66	19.35	17.70	91.11
-06	27.23	26.90	20.40	19.80	94.33
-12	30.13	28.30	20.05	22.75	101.23

I.H.P.

Time	H.P.		L.P.		Total
	H.F.	C.E.	H.F.	C.E.	I.H.P.
4-18	30.79	32.20	23.80	25.05	111.84
-24	29.95	31.30	23.37	24.30	108.92
-30	23.10	23.90	11.80	11.00	69.80
-36	26.59	25.89	18.90	19.60	90.98

Year	1914	1915	1916	1917	1918
1914	80.00	81.00	82.00	83.00	84.00
1915	85.00	86.00	87.00	88.00	89.00
1916	90.00	91.00	92.00	93.00	94.00
1917	95.00	96.00	97.00	98.00	99.00
1918	100.00	101.00	102.00	103.00	104.00

TABLE VII.
INDICATED HORSE POWER
for
EIGHT MINUTE INTERVALS
with
SIMULTANEOUS READINGS.

• **TV ads:**

597

0.720

CARDS TAKEN SIMULTANEOUSLY.

INTERVAL = 8 MINUTES.

I.H.P.

	H.P.		L.P.		Total
Time	H.F.	C.F.	H.F.	C.F.	I.H.P.
9-12	14.56	17.35	10.52	10.52	52.95
-20	18.04	18.42	11.70	10.60	58.76
-28	18.62	17.65	11.04	11.49	58.80
-36	17.62	17.45	11.40	10.75	57.22
-44	17.45	17.75	10.11	13.06	58.37
-52	18.64	17.82	11.62	11.76	59.84
10-00	18.50	17.96	12.90	11.45	60.81
-08	17.68	19.04	11.62	9.54	57.88
-16	18.92	17.07	11.65	10.63	58.27
-24	19.58	17.64	15.82	8.46	61.50
-32	18.22	18.74	12.15	11.05	60.16
-40	19.73	18.74	12.04	11.94	62.45
-48	19.78	20.59	11.70	8.83	60.90
-56	17.79	17.84	11.80	10.62	58.05
11-04	16.63	17.88	11.30	11.89	57.70
-12	No card taken.				
-14	18.15	16.59	9.80	10.62	55.16
-20	22.38	16.94	13.90	10.16	63.38
-28	15.90	14.03	9.90	9.44	49.27
-36	15.45	19.25	9.50	11.20	55.40
-44	14.70	16.51	8.40	10.49	50.10
-52	No card.		Indicator string broken.		
12-00	" "		" "	" "	
-02	9.32	5.88	.99	2.76	18.95
-08	7.40	7.44	1.00	2.79	18.63

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.F.	H.E.	C.F.	I.H.P.
12-16	7.06	6.74	.84	2.36	17.00
-24	6.50	9.63	.85	3.36	20.34
-32	7.62	8.11	1.15	2.81	19.69
-40	7.36	7.05	1.13	2.90	18.44
-48	6.74	7.84	1.35	2.79	18.72
-56	Card incomplete.				
1-02	8.09	10.59	1.22	3.87	23.77
-04	8.06	10.54	1.28	4.07	23.95
-12	19.00	17.40	15.96	12.30	64.66
-20	18.70	16.90	11.40	10.90	57.90
-28	18.00	17.55	10.20	10.22	55.97
-36	17.70	17.80	11.75	11.23	58.48
-44	18.30	17.20	12.30	11.10	58.90
-52	19.25	16.60	12.20	11.60	59.65
2-00	19.05	17.30	11.62	11.10	59.07
-08	18.10	18.30	11.48	10.70	58.58
-16	17.10	17.20	10.30	10.70	55.30
-24	16.93	16.70	11.40	10.64	55.67
-32	17.34	17.84	11.50	10.15	56.83
-40	17.32	16.80	12.70	11.90	58.72
-48	17.77	18.72	12.00	11.70	60.19
-56	21.35	20.28	13.70	13.60	68.93
3-04	20.65	20.21	15.20	14.96	71.02
-12	21.66	20.13	16.32	13.62	71.73
-20	21.10	20.79	15.00	14.82	71.71
-28	25.61	23.30	18.73	16.71	84.35

1847	7.2	7.3	7.4	7.5	7.6
80.71	82.7	83.	84.4	85.7	81-82
82.08	83.2	84.	85.8	86.3	82-
83.92	85.3	86.1	87.3	88.7	83-
85.33	87.3	88.1	89.7	90.7	84-
87.82	89.3	90.1	91.3	92.8	85-
alignment base					86-
77.02	78.2	79.1	80.01	80.2	80-1
79.02	80.4	81.1	82.01	82.3	80-
81.81	82.21	83.11	84.71	85.11	81-
83.78	84.01	85.11	86.11	87.11	82-
85.11	86.01	87.01	88.71	89.11	83-
86.08	87.11	88.11	89.71	90.71	84-
88.08	89.11	90.11	91.71	92.11	85-
90.08	91.11	92.11	93.71	94.11	86-
92.08	93.11	94.11	95.71	96.11	87-
94.08	95.11	96.11	97.71	98.11	88-
96.08	97.11	98.11	99.71	100.11	89-1
98.08	99.11	100.11	101.71	102.11	90-
100.08	101.11	102.11	103.71	104.11	91-
102.08	103.11	104.11	105.71	106.11	92-
104.08	105.11	106.11	107.71	108.11	93-
106.08	107.11	108.11	109.71	110.11	94-
108.08	109.11	110.11	111.71	112.11	95-
110.08	111.11	112.11	113.71	114.11	96-
112.08	113.11	114.11	115.71	116.11	97-
114.08	115.11	116.11	117.71	118.11	98-
116.08	117.11	118.11	119.71	120.11	99-
118.08	119.11	120.11	121.71	122.11	100-

I.H.P.

Time	H.P.		L.P.		Total
	H.F.	C.F.	H.F.	C.F.	I.H.P.
3-36	24.38	22.71	18.23	18.05	83.37
-44	24.95	24.76	18.60	19.68	87.99
-52	25.49	27.46	18.26	17.53	88.74
4-00	25.40	28.66	19.35	17.70	91.11
-08	Card incomplete.				
-12	30.13	28.30	20.05	22.75	101.23
-16	30.69	31.10	24.00	24.02	109.81
-24	29.95	31.30	23.37	24.30	108.92
-32	26.88	26.39	18.00	18.70	89.97
-40	27.60	26.06	19.80	20.05	93.51

Exam	2013		2012		
13.1.1	88.0	88.0	88.0	88.0	100
14.1.1	89.0	89.0	89.0	89.0	100
15.1.1	90.0	90.0	90.0	90.0	100
16.1.1	91.0	91.0	91.0	91.0	100
17.1.1	92.0	92.0	92.0	92.0	100
18.1.1	93.0	93.0	93.0	93.0	100
19.1.1	94.0	94.0	94.0	94.0	100
20.1.1	95.0	95.0	95.0	95.0	100
21.1.1	96.0	96.0	96.0	96.0	100
22.1.1	97.0	97.0	97.0	97.0	100
23.1.1	98.0	98.0	98.0	98.0	100
24.1.1	99.0	99.0	99.0	99.0	100
25.1.1	100.0	100.0	100.0	100.0	100

TABLE VIII
INDICATED HORSE POWER
for
TEN MINUTE INTERVALS
with
SIMULTANEOUS READINGS.

1019 11207
NEWTON WOODS DETAIL
No. 1
THE NEWTON WOODS DETAIL
OFFICE
NEWTON WOODS DETAIL

CARDS TAKEN SIMULTANEOUSLY.

INTERVAL = 10 MINUTES.

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56	17.35	10.52	10.52	52.95
-22	19.54	18.74	13.24	10.72	62.24
-32	18.04	18.96	11.66	9.91	58.57
-42	18.43	18.10	10.37	12.88	59.78
-52	18.64	17.82	11.62	11.76	59.84
10-02	18.69	17.96	12.57	10.66	59.88
-12	18.36	16.85	12.60	11.29	59.10
-22	19.77	16.85	12.60	10.57	59.59
-32	18.22	18.74	12.15	11.05	60.16
-42	19.78	16.59	10.40	8.83	55.60
-52	18.85	19.77	11.44	12.43	62.49
11-02	16.59	17.22	10.00	12.32	56.13
-12	No card taken.				
-14	18.15	16.59	9.80	10.62	55.16
-22	16.73	14.79	10.20	11.57	53.09
-32	15.43	16.70	9.50	11.86	53.49
-42	14.07	16.78	9.40	10.41	50.66
-52	No card.		Indicator string broken.		
12-02	9.32	5.88	.99	2.76	18.95
-12	7.41	6.40	.84	2.59	17.24
-22	6.99	8.48	.84	3.33	19.64
-32	7.62	8.11	1.15	2.81	19.69
-42	7.15	7.92	1.35	3.09	19.51
-52	5.46	8.63	1.14	3.20	18.43

• • •

Lat/Long	N. 2		N. 3		W. 1
11.00	11.00	11.00	11.00	11.00	11.00
12.00	12.00	12.00	12.00	12.00	12.00
13.00	13.00	13.00	13.00	13.00	13.00
14.00	14.00	14.00	14.00	14.00	14.00
15.00	15.00	15.00	15.00	15.00	15.00
16.00	16.00	16.00	16.00	16.00	16.00
17.00	17.00	17.00	17.00	17.00	17.00
18.00	18.00	18.00	18.00	18.00	18.00
19.00	19.00	19.00	19.00	19.00	19.00
20.00	20.00	20.00	20.00	20.00	20.00
21.00	21.00	21.00	21.00	21.00	21.00
22.00	22.00	22.00	22.00	22.00	22.00
23.00	23.00	23.00	23.00	23.00	23.00
24.00	24.00	24.00	24.00	24.00	24.00
25.00	25.00	25.00	25.00	25.00	25.00
26.00	26.00	26.00	26.00	26.00	26.00
27.00	27.00	27.00	27.00	27.00	27.00
28.00	28.00	28.00	28.00	28.00	28.00
29.00	29.00	29.00	29.00	29.00	29.00
30.00	30.00	30.00	30.00	30.00	30.00

91.00	85.01	04.0	92.51	81.51	11-
90.00	84.01	08.01	90.51	80.51	12-
89.00	83.01	02.0	89.51	79.51	13-
88.00	82.01	04.0	87.51	78.51	14-

to card. Indicator action proper.

00.01	59.0	60.	00.0	00.0	00-01
01.01	00.0	00.	00.0	00.0	01-01
02.01	00.0	00.	00.0	00.0	02-01
03.01	00.0	00.	00.0	00.0	03-01
04.01	00.0	00.	00.0	00.0	04-01
05.01	00.0	00.	00.0	00.0	05-01
06.01	00.0	00.	00.0	00.0	06-01
07.01	00.0	00.	00.0	00.0	07-01
08.01	00.0	00.	00.0	00.0	08-01
09.01	00.0	00.	00.0	00.0	09-01
10.01	00.0	00.	00.0	00.0	10-01
11.01	00.0	00.	00.0	00.0	11-01
12.01	00.0	00.	00.0	00.0	12-01

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
1-02	8.09	10.59	1.22	3.87	23.77
-12	19.00	17.40	15.96	12.30	64.66
-22	19.20	17.75	10.38	10.49	57.82
-32	17.50	18.60	11.12	11.05	58.27
-42	17.95	17.60	11.40	10.90	57.85
-52	19.25	16.60	12.20	11.60	59.65
2-02	18.40	17.80	11.60	11.62	59.42
-12	17.30	19.10	10.30	10.70	57.40
-22	19.76	18.47	11.66	10.60	60.49
-32	17.34	17.84	11.50	10.15	56.83
-42	18.18	19.14	11.90	12.65	61.87
-52	22.18	19.53	14.20	14.20	70.11
3-02	20.72	22.38	15.60	15.26	73.96
-12	21.66	20.13	16.32	13.62	71.73
-22	23.13	21.10	19.80	17.86	81.89
-32	25.43	24.76	17.05	17.50	84.74
-42	24.72	23.99	18.05	17.90	84.66
-52	25.49	27.46	18.26	17.53	88.74
4-02	26.53	26.10	18.20	18.50	89.33
-12	30.13	28.30	20.05	22.75	101.23
-22	31.71	31.50	23.37	24.30	110.88
-32	26.88	26.39	18.00	18.70	89.97

TABLE IX.
 INDICATED HORSE POWER
 for
 TWO MINUTE INTERVALS
 with
 CARDS TAKEN
 in
 ROTATION.

CARDS TAKEN IN ROTATION.

INTERVAL = 2 MINUTES.

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56				
-14		18.01			
-16			10.52		
-18				11.68	54.77
-20	18.04				
-22		18.74			
-24			11.61		
-26				10.21	58.60
-28	18.62				
-30		19.57			
-32			11.66		
-34				9.91	59.76
-36	17.62				
-38		18.39			
-40			12.05		
-42				12.88	60.94
-44	17.45				
-46		18.84			
-48			10.37		
-50				12.39	59.05
-52	18.64				
-54		16.58			
-56			12.90		
-58				11.63	59.75

APPENDIX 2 (continued)			APPENDIX 3 (continued)		
Year	Age	Sex	Year	Age	Sex
1950	10.0	M	1950	10.0	M
1951	10.0	M	1951	10.0	M
1952	10.0	M	1952	10.0	M
1953	10.0	M	1953	10.0	M
1954	10.0	M	1954	10.0	M
1955	10.0	M	1955	10.0	M
1956	10.0	M	1956	10.0	M
1957	10.0	M	1957	10.0	M
1958	10.0	M	1958	10.0	M
1959	10.0	M	1959	10.0	M
1960	10.0	M	1960	10.0	M
1961	10.0	M	1961	10.0	M
1962	10.0	M	1962	10.0	M
1963	10.0	M	1963	10.0	M
1964	10.0	M	1964	10.0	M
1965	10.0	M	1965	10.0	M
1966	10.0	M	1966	10.0	M
1967	10.0	M	1967	10.0	M
1968	10.0	M	1968	10.0	M
1969	10.0	M	1969	10.0	M
1970	10.0	M	1970	10.0	M
1971	10.0	M	1971	10.0	M
1972	10.0	M	1972	10.0	M
1973	10.0	M	1973	10.0	M
1974	10.0	M	1974	10.0	M
1975	10.0	M	1975	10.0	M
1976	10.0	M	1976	10.0	M
1977	10.0	M	1977	10.0	M
1978	10.0	M	1978	10.0	M
1979	10.0	M	1979	10.0	M
1980	10.0	M	1980	10.0	M
1981	10.0	M	1981	10.0	M
1982	10.0	M	1982	10.0	M
1983	10.0	M	1983	10.0	M
1984	10.0	M	1984	10.0	M
1985	10.0	M	1985	10.0	M
1986	10.0	M	1986	10.0	M
1987	10.0	M	1987	10.0	M
1988	10.0	M	1988	10.0	M
1989	10.0	M	1989	10.0	M
1990	10.0	M	1990	10.0	M
1991	10.0	M	1991	10.0	M
1992	10.0	M	1992	10.0	M
1993	10.0	M	1993	10.0	M
1994	10.0	M	1994	10.0	M
1995	10.0	M	1995	10.0	M
1996	10.0	M	1996	10.0	M
1997	10.0	M	1997	10.0	M
1998	10.0	M	1998	10.0	M
1999	10.0	M	1999	10.0	M
2000	10.0	M	2000	10.0	M
2001	10.0	M	2001	10.0	M
2002	10.0	M	2002	10.0	M
2003	10.0	M	2003	10.0	M
2004	10.0	M	2004	10.0	M
2005	10.0	M	2005	10.0	M
2006	10.0	M	2006	10.0	M
2007	10.0	M	2007	10.0	M
2008	10.0	M	2008	10.0	M
2009	10.0	M	2009	10.0	M
2010	10.0	M	2010	10.0	M
2011	10.0	M	2011	10.0	M
2012	10.0	M	2012	10.0	M
2013	10.0	M	2013	10.0	M
2014	10.0	M	2014	10.0	M
2015	10.0	M	2015	10.0	M
2016	10.0	M	2016	10.0	M
2017	10.0	M	2017	10.0	M
2018	10.0	M	2018	10.0	M
2019	10.0	M	2019	10.0	M
2020	10.0	M	2020	10.0	M

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
10-00	18.50				
-02		17.96			
-04			12.32		
-06				10.66	59.44
-08	17.68				
-10		16.81			
-12			12.60		
-14				11.79	58.88
-16	18.92				
-18		18.08			
-20			16.70		
-22				10.57	64.27
-24	19.58				
-26		16.85			
-28			16.00		
-30				8.36	60.79
-32	18.22				
-34		18.32			
-36			11.00		
-38				12.64	60.18
-40	19.73				
-42		16.59			
-44			10.40		
-46				8.84	55.56
-48	19.78				
-50		18.48			

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
10-52			11.44		
-54				11.49	61.19
-56	17.79				
-58		18.64			
11-00			10.85		
-02				12.32	59.60
-04	16.63				
-06		16.82			
-08			9.90		
-10				11.37	54.72
-12		No card taken.			
-14	18.15				
-16		16.32			
-18			10.00		
-20				10.16	54.63
-22	16.73				
-24		13.92			
-26			10.00		
-28				9.44	50.09
-30		No card taken.			
-32	15.43				
-34		20.43			
-36			9.50		
-38				11.70	57.06
-40	15.43				
-42		16.78			

	I.H.P.				
	H.P.		L.P.		Total
Time	H.E.	C.E.	H.E.	C.E.	I.H.P.
11-44			8.40		
-46				9.71	50.32
-48	15.30				
-50		16.41			
-52		No cards taken.			
-54		Indicator string broken.			
-56					
-58					
12-00					
-02			.99		
-04				2.79	35.49
-06	7.40				
-08		7.44			
-10			1.00		
-12				2.59	18.43
-14	8.40				
-16		6.74			
-18			.83		
-20				2.58	18.75
-22	6.99				
-24		9.63			
-26			.84		
-28				3.37	20.83
-30	7.26				
-32		8.11			
-34		No cards taken.			

I.H.P.

Time	H.P.		I.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
12-36		No cards taken.			
-38		" "	"		
-40			1.13		
-42				3.09	19.59
-44	6.90				
-46		7.23			
-48			1.35		
-50		No card taken.			
-52				3.20	18.68
-54	6.27				
-56		Cards incomplete			
-58		"	"		
1-00		"	"		
-02		10.59			
-04			1.28		
-06				4.67	22.81
-08	14.10				
-10		16.84			
-12			15.96		
-14				12.98	59.88
-16	18.35				
-18		17.40			
-20			11.40		
-22				10.49	57.64
-24	18.50				
-26		17.15			

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
1-28			10.20		
-30				10.62	56.47
-32	17.50				
-34		17.05			
-36			11.75		
-38				11.20	57.50
-40	17.75				
-42		17.60			
-44			12.30		
-46				11.10	58.75
-48	17.30				
-50		17.60			
-52			12.20		
-54				11.40	58.50
-56	18.75				
-58		18.00			
2-00			11.62		
-02				11.62	59.99
-04	18.50				
-06		18.70			
-08			11.48		
-10				10.50	59.18
-12	17.30				
-14		18.10			
-16			10.30		
-18				10.90	56.60

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
2-20	17.40				
-22		18.47			
-24			11.40		
-26				10.64	57.91
-28	17.74				
-30		15.97			
-32			11.50		
-34				10.00	55.21
-36	18.57				
-38		15.82			
-40			12.70		
-42				12.65	59.74
-44	18.45				
-46		17.36			
-48			12.00		
-50				12.80	60.61
-52	22.18				
-54		20.77			
-56			13.70		
-58				14.80	71.45
3-00	21.61				
-02		22.38			
-04			15.20		
-06				15.42	74.61
-08	17.99				
-10		19.72			

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
3-12			16.32		
-14				13.80	68.83
-16	21.11				
-18		20.42			
-20			15.00		
-22				17.86	74.39
-24	22.16				
-26		25.23			
-28			18.73		
-30				17.80	83.92
-32	25.43				
-34		24.62			
-36			18.23		
-38				17.02	85.30
-40	24.92				
-42		23.99			
-44			18.60		
-46				17.80	85.31
-48	24.80				
-50		26.23			
-52			18.26		
-54				18.48	87.77
-56	24.88				
-58		27.02			
4-00			19.35		
-02				18.50	89.75

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
4-04	27.22				
-06		26.90			
-08		Incomplete card.			
-10		"	"		
-12			20.05		
-14				22.90	87.07
-16	30.69				
-18		32.20			
-20			24.85		
-22				24.30	112.04
-24	29.95				
-26		30.40			
-28			17.08		
-30				11.00	88.43
-32	26.88				
-34		26.94			
-36			18.90		
-38				19.90	92.62

1950		1951		1952		MAT
1950-1	1950-2	1950-3	1950-4	1950-5	1950-6	
					00.00	00-1
				00.00		00-2
			00.00			00-3
			00.00			00-4
			00.00			00-5
00.00	00.00					00-6
					00.00	00-7
				00.00		00-8
		00.00				00-9
00.00	00.00					00-10
					00.00	00-11
				00.00		00-12
		00.00				00-13
					00.00	00-14
				00.00		00-15
00.00	00.00					00-16
					00.00	00-17
				00.00		00-18
		00.00				00-19
00.00	00.00					00-20

TABLE X.
INDICATED HORSE POWER
for
FOUR MINUTE INTERVALS
with
CARDS TAKEN
in
ROTATION.

THE LIBRARY

OF THE

UNIVERSITY

OF CALIFORNIA

BERKELEY

1911

10

10000000

CARDS TAKEN IN ROTATION.

INTERVAL = 4 MINUTES.

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56				
-16		17.73			
-20			11.70		
-24				11.82	54.81
-28	18.62				
-32		18.96			
-36			11.40		
-40				10.36	59.34
-44	17.45				
-48		19.00			
-52			11.62		
-56				11.67	59.74
10-00	18.50				
-04		17.40			
-08			11.62		
-12				11.29	58.81
-16	18.92				
-20		18.41			
-24			15.82		
-28				9.72	62.87
-32	18.22				
-36		18.74			
-40			12.04		
-44				8.83	57.83
-48	19.78				

• • •

[illegible]

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
10-52		19.77			
-56			11.80		
11-00				12.76	64.11
-04	16.63				
-08		16.78			
-12		No card taken.			
-14			9.80		
-16				10.16	53.37
-20	22.38				
-24		13.92			
-28			9.90		
-32				11.86	58.06
-36	15.45				
-40		16.70			
-44			8.40		
-48				9.53	50.08
-52	12.96				
-56		No cards taken			
12-00		Indicator string broken.			
-02		5.88			
-04			1.00		
-08				2.79	22.63
-12	7.41				
-16		6.74			
-20			.84		
-24				3.36	18.35

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I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
12-28	7.00				
-32		8.11			
-36		No card taken.			
-40			1.13		
-44				2.79	19.03
-48	6.74				
-52		8.63			
-56		Cards incomplete.			
1-00		"	"		
-02			1.22		
-04				4.07	20.66
-08	14.10				
-12		17.40			
-16			11.58		
-20				10.90	53.98
-24	18.50				
-28		17.55			
-32			11.23		
-36				11.23	58.51
-40	17.75				
-44		17.20			
-48			12.30		
-52				11.60	58.85
-56	18.75				
2-00		17.30			
-04			11.44		

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
2-08				10.70	58.19
-12	17.30				
-16		17.20			
-20			10.20		
-24				10.64	55.34
-28	17.74				
-32		17.84			
-36			12.40		
-40				11.90	59.88
-44	18.45				
-48		18.72			
-52			14.20		
-56				13.60	64.97
3-00	21.61				
-04		20.21			
-08			14.10		
-12				13.62	69.54
-16	21.11				
-20		20.79			
-24			19.30		
-28				16.71	77.91
-32	25.43				
-36		22.71			
-40			18.40		
-44				19.68	86.22
-48	24.80				

1940	1941	1942	1943	1944	1945
11.01	11.01	11.01	11.01	11.01	11.01
11.02	11.02			11.02	11.02
				11.03	11.03
			11.04		11.04
		11.05			11.05
11.06	11.06			11.06	11.06
			11.07		11.07
		11.08			11.08
11.09	11.09			11.09	11.09
			11.10		11.10
		11.11			11.11
11.12	11.12			11.12	11.12
			11.13		11.13
		11.14			11.14
11.15	11.15			11.15	11.15
			11.16		11.16
		11.17			11.17
11.18	11.18			11.18	11.18
			11.19		11.19
		11.20			11.20
11.21	11.21			11.21	11.21
			11.22		11.22
		11.23			11.23
11.24	11.24			11.24	11.24
			11.25		11.25
		11.26			11.26
11.27	11.27			11.27	11.27
			11.28		11.28
		11.29			11.29
11.30	11.30			11.30	11.30

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
3-52		27.46			
-56			18.30		
4-00				17.70	88.26
-04	25.70				
-08		Incomplete card.			
-12		28.30			
-16			24.00		
-20				25.08	103.08
-24	29.95				
-28		30.00			
-32			18.00		
-36				19.60	97.55

1888	1889	1890	1891	1892	1893
18, 19	19, 20	20, 21	21, 22	22, 23	23, 24
			24, 25		25, 26
		26, 27			27, 28
28, 29	29, 30			30, 31	31, 32
					32, 33
					33, 34
					34, 35
					35, 36
					36, 37
					37, 38
					38, 39
					39, 40
					40, 41
					41, 42
					42, 43
					43, 44
					44, 45
					45, 46
					46, 47
					47, 48
					48, 49
					49, 50
					50, 51
					51, 52
					52, 53
					53, 54
					54, 55
					55, 56
					56, 57
					57, 58
					58, 59
					59, 60
					60, 61
					61, 62
					62, 63
					63, 64
					64, 65
					65, 66
					66, 67
					67, 68
					68, 69
					69, 70
					70, 71
					71, 72
					72, 73
					73, 74
					74, 75
					75, 76
					76, 77
					77, 78
					78, 79
					79, 80
					80, 81
					81, 82
					82, 83
					83, 84
					84, 85
					85, 86
					86, 87
					87, 88
					88, 89
					89, 90
					90, 91
					91, 92
					92, 93
					93, 94
					94, 95
					95, 96
					96, 97
					97, 98
					98, 99
					99, 100

TABLE XI.
INDICATED HORSE POWER
for
SIX MINUTE INTERVALS
with
CARDS TAKEN
in
ROTATION.

THE FIRST
SECTION OF THE
THE
THE SECOND SECTION
THE
THE THIRD SECTION
THE
THE FOURTH SECTION
THE
THE FIFTH SECTION

CARDS TAKEN IN ROTATION.

INTERVAL = 6 MINUTES.

I.H.P.

Time	H.P.		L.P.		Total
	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56				
-18		17.81			
-24			11.61		
-30				11.06	55.04
-36	17.62				
-42		18.10			
-48			10.37		
-54				11.67	57.76
10-00	18.50				
-06		17.83			
-12			12.60		
-18				10.63	59.56
-24	19.58				
-30		18.32			
-36			11.00		
-42				8.83	57.73
-48	19.78				
-54		17.26			
11-00			10.85		
-06				11.69	59.58
-12		No card taken.			
-14	18.15				
-18		17.03			
-24			10.60		
-30		No card taken.			

I.H.P.

	H.P.		L.P.		Total
Time	H.E.	C.E.	H.E.	C.E.	I.H.P.
11-32				11.86	57.64
-36	15.45				
-42		16.78			
-48			8.30		
-54		No cards taken.			
12-00		Indicator string broken.			
-02				2.76	43.29
-06	7.40				
-12		6.40			
-18			.83		
-24				3.36	17.99
-30	7.26				
-36		No card taken.			
-40		7.05			
-42			1.35		
-48				2.79	18.45
-54	6.27				
1-00		Card incomplete.			
-02		10.59			
-06			1.41		
-12				12.30	30.57
-18	19.35				
-24		18.35			
-30			10.30		
-36				11.23	59.23
-42	17.95				

I.H.P.

Time	H.P.		L.P.		Total
	H.F.	C.F.	H.F.	C.F.	I.H.P.
1-48		17.60			
-54			11.75		
2-00				11.10	58.40
-06	18.00				
-12		19.10			
-18			10.40		
-24				10.64	58.14
-30	16.41				
-36		16.97			
-42			11.90		
-48				11.70	56.98
-54	21.16				
3-00		22.34			
-06			14.70		
-12				13.62	71.82
-18	21.54				
-24		23.27			
-30			17.27		
-36				18.05	80.13
-42	24.72				
-48		24.64			
-54			18.48		
4-00				17.70	85.54
-06	27.23				
-12		28.30			

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I.H.P.

	H.P.		L.P.		Total
Time	H.F.	C.F.	H.F.	C.F.	I.H.P.
4-18			23.80		
-24				24.30	103.63

NAME	DATE	TIME	PLACE	REMARKS
1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.	1. 1. 1.
2. 1. 1.	2. 1. 1.	2. 1. 1.	2. 1. 1.	2. 1. 1.
3. 1. 1.	3. 1. 1.	3. 1. 1.	3. 1. 1.	3. 1. 1.
4. 1. 1.	4. 1. 1.	4. 1. 1.	4. 1. 1.	4. 1. 1.
5. 1. 1.	5. 1. 1.	5. 1. 1.	5. 1. 1.	5. 1. 1.
6. 1. 1.	6. 1. 1.	6. 1. 1.	6. 1. 1.	6. 1. 1.
7. 1. 1.	7. 1. 1.	7. 1. 1.	7. 1. 1.	7. 1. 1.
8. 1. 1.	8. 1. 1.	8. 1. 1.	8. 1. 1.	8. 1. 1.
9. 1. 1.	9. 1. 1.	9. 1. 1.	9. 1. 1.	9. 1. 1.
10. 1. 1.	10. 1. 1.	10. 1. 1.	10. 1. 1.	10. 1. 1.

TABLE XII.
INDICATED HORSE POWER
for
EIGHT MINUTE INTERVALS
with
CARDS TAKEN
in
ROTATION.

CARDS TAKEN IN ROTATION.

INTERVAL = 8 MINUTES.

I.H.P.

	H.P.		L.P.		Total
Time	H.E.	C.E.	H.E.	C.E.	I.H.P.
9-12	14.56				
-20		18.42			
-28			11.04		
-36				10.75	54.77
-44					
-52	18.64				
10-00		17.96			
-08			11.62		
-16				10.63	58.85
-24	19.58				
-32		18.74			
-40			12.04		
-48				8.83	59.19
-56	17.79				
11-04		17.88			
-12		No card taken.			
-14			9.80		
-20				10.16	55.63
-28	15.90				
-36		19.25			
-44			8.40		
-52		No cards taken.			
12-00		Indicator string broken.			
-02				2.76	46.31
-08	7.40				

I.H.P.

Time	H.P.		L.P.		Total
	H.F.	C.F.	H.F.	C.F.	I.H.P.
12-16		6.74			
-24			.85		
-32				2.81	17.80
-40	7.36				
-48		7.84			
-56		Card incomplete.			
1-02			1.22		
-04				4.07	20.49
-12	19.00				
-20		16.90			
-28			10.20		
-36				11.23	57.33
-44	18.30				
-52		16.60			
2-00			11.62		
-08				10.70	57.22
-16	17.10				
-24		16.70			
-32			11.50		
-40				11.90	57.20
-48	17.77				
-56		20.28			
3-04			15.20		
-12				13.62	66.87
-20	21.10				
-28		23.30			

I.H.P.

	H.P.		L.P.		Total
Time	H.F.	C.F.	H.F.	C.F.	I.H.P.
3-36			18.23		
-44				19.68	82.31
-52	25.49				
4-00		28.66			
-08		Card incomplete.			
-12			20.05		
-16				24.02	99.22

TABLE XIII.
INDICATED HORSE POWER
for
TEN MINUTE INTERVALS
with
CARDS TAKEN
in
ROTATION.

THE FIRST
AND SECOND EDITIONS
OF
THE HISTORY OF THE
CITY
OF
NEW YORK
BY
J. B. H. H. H.

CARDS TAKEN IN ROTATION.

INTERVAL = 10 MINUTES.

I.H.P.

Time	H.P.		L.P.		Total
	H.F.	C.F.	H.F.	C.F.	I.H.P.
9-12	14.56				
-22		18.74			
-32			11.66		
-42				12.88	57.84
-52	18.64				
10-02		17.96			
-12			12.60		
-22				10.57	59.77
-32	18.22				
-42		16.59			
-52			11.44		
11-02				12.32	58.57
-12		No card taken.			
-14	18.15				
-22		14.79			
-32			9.50		
-42				10.41	52.85
-52	12.96				
12-02		5.88			
-12			.84		
-22				3.33	23.01
-32	7.62				
-42		7.92			
-52			1.14		
1-02				3.87	20.55

RECORDS

1892	1893	1894	1895	1896	1897
1892	1893	1894	1895	1896	1897
				1896	1897
			1895		1896
		1894			1895
1893	1894				1896
				1895	1896
		1894			1895
1894	1895				1896
				1894	1895
		1893			1894
1895	1896				1897
				1894	1895
		1894			1896
1896	1897				1898
				1895	1896
		1895			1897
1897	1898				1899
				1896	1897
		1896			1898
1898	1899				1900
				1897	1898
		1897			1899
1899	1900				1901
				1898	1899
		1898			1900
1900	1901				1902
				1899	1900
		1899			1901
1901	1902				1903
				1900	1901
		1900			1902
1902	1903				1904
				1901	1902
		1901			1903
1903	1904				1905
				1902	1903
		1902			1904
1904	1905				1906
				1903	1904
		1903			1905
1905	1906				1907
				1904	1905
		1904			1906
1906	1907				1908
				1905	1906
		1905			1907
1907	1908				1909
				1906	1907
		1906			1908
1908	1909				1910
				1907	1908
		1907			1909
1909	1910				1911
				1908	1909
		1908			1910
1910	1911				1912
				1909	1910
		1909			1911
1911	1912				1913
				1910	1911
		1910			1912
1912	1913				1914
				1911	1912
		1911			1913
1913	1914				1915
				1912	1913
		1912			1914
1914	1915				1916
				1913	1914
		1913			1915
1915	1916				1917
				1914	1915
		1914			1916
1916	1917				1918
				1915	1916
		1915			1917
1917	1918				1919
				1916	1917
		1916			1918
1918	1919				1920
				1917	1918
		1917			1919
1919	1920				1921
				1918	1919
		1918			1920
1920	1921				1922
				1919	1920
		1919			1921
1921	1922				1923
				1920	1921
		1920			1922
1922	1923				1924
				1921	1922
		1921			1923
1923	1924				1925
				1922	1923
		1922			1924
1924	1925				1926
				1923	1924
		1923			1925
1925	1926				1927
				1924	1925
		1924			1926
1926	1927				1928
				1925	1926
		1925			1927
1927	1928				1929
				1926	1927
		1926			1928
1928	1929				1930
				1927	1928
		1927			1929
1929	1930				1931
				1928	1929
		1928			1930
1930	1931				1932
				1929	1930
		1929			1931
1931	1932				1933
				1930	1931
		1930			1932
1932	1933				1934
				1931	1932
		1931			1933
1933	1934				1935
				1932	1933
		1932			1934
1934	1935				1936
				1933	1934
		1933			1935
1935	1936				1937
				1934	1935
		1934			1936
1936	1937				1938
				1935	1936
		1935			1937
1937	1938				1939
				1936	1937
		1936			1938
1938	1939				1940
				1937	1938
		1937			1939
1939	1940				1941
				1938	1939
		1938			1940
1940	1941				1942
				1939	1940
		1939			1941
1941	1942				1943
				1940	1941
		1940			1942
1942	1943				1944
				1941	1942
		1941			1943
1943	1944				1945
				1942	1943
		1942			1944
1944	1945				1946
				1943	1944
		1943			1945
1945	1946				1947
				1944	1945
		1944			1946
1946	1947				1948
				1945	1946
		1945			1947
1947	1948				1949
				1946	1947
		1946			1948
1948	1949				1950
				1947	1948
		1947			1949
1949	1950				1951
				1948	1949
		1948			1950
1950	1951				1952
				1949	1950
		1949			1951
1951	1952				1953
				1950	1951
		1950			1952
1952	1953				1954
				1951	1952
		1951			1953
1953	1954				1955
				1952	1953
		1952			1954
1954	1955				1956
				1953	1954
		1953			1955
1955	1956				1957
				1954	1955
		1954			1956
1956	1957				1958
				1955	1956
		1955			1957
1957	1958				1959
				1956	1957
		1956			1958
1958	1959				1960
				1957	1958
		1957			1959
1959	1960				1961
				1958	1959
		1958			1960
1960	1961				1962
				1959	1960
		1959			1961
1961	1962				1963
				1960	1961
		1960			1962
1962	1963				1964
				1961	1962
		1961			1963
1963	1964				1965
				1962	1963
		1962			1964
1964	1965				1966
				1963	1964
		1963			1965
1965	1966				1967
				1964	1965
		1964			1966
1966	1967				1968
				1965	1966
		1965			1967
1967	1968				1969
				1966	1967
		1966			1968
1968	1969				1970
				1967	1968
		1967			1969
1969	1970				1971
				1968	1969
		1968			1970
1970	1971				1972
				1969	1970
		1969			1971
1971	1972				1973
				1970	1971
		1970			1972
1972	1973				1974
				1971	1972
		1971			1973
1973	1974				1975
				1972	1973
		1972			1974
1974	1975				1976
				1973	1974
		1973			1975
1975	1976				1977
				1974	1975
		1974			1976
1976	1977				1978
				1975	1976
		1975			1977
1977	1978				1979
				1976	1977
		1976			1978
1978	1979				1980
				1977	1978
		1977			1979
1979	1980				1981
				1978	1979
		1978			1980
1980	1981				1982
				1979	1980
		1979			1981
1981	1982				1983
				1980	1981
		1980			1982
1982	1983				1984
				1981	1982
		1981			1983
1983	1984				1985
				1982	1983
		1982			1984
1984	1985				1986
				1983	1984
		1983			1985
1985	1986				1987
				1984	1985
		1984			1986
1986	1987				1988
				1985	1986
		1985			1987
1987	1988				1989
				1986	1987
		1986			1988
1988	1989				1990
				1987	1988
		1987			

I.H.P.

	H.P.	L.P.	Total
1-12	19.00		
-22	17.75		
-32		11.12	
-42		10.90	58.77
-52	19.25		
2-02	17.80		
-12		10.30	
-22		10.60	57.95
-32	17.34		
-42	19.14		
-52		14.20	
3-02		15.26	65.94
-12	21.66		
-22	21.10		
-32		17.05	
-42		17.90	77.71
-52	25.49		
4-02	26.10		
-12		20.05	
-22		24.30	95.94

1947	1948	1949	1950
		08.71	01-1
		01.71	02-
	01.11		03-
07.33	08.02		04-
		03.71	05-
		08.71	06-2
	02.01		07-
08.75	08.01		08-
		04.71	09-
		01.71	10-
	05.31		11-
09.30	09.11		12-3
		05.30	01-
		02.15	02-
	03.77		03-
05.15	08.71		04-
		04.30	05-
		01.30	06-8
	09.06		07-
09.30	02.18		08-

SERIES A.

TABLES XIV TO XVIII INCLUSIVE.

EFFECT ON THE RESULT FOR AVERAGE HORSE POWER
OF THE INTERVAL BETWEEN READINGS.

LA CRUISE

INTERLUDE: LEVEE OF THE RAINY

SCENE: AROUND KALAMITA WAYS THROUGH THE RED FOREST

SCENICALLY SENSITIVE LANDSCAPE NOT TO

TABLE XIV.
SERIES A. NUMBER 1.
RESULTS WITH TWO MINUTE
INTERVALS.

.VIZ WHAT

.J. HARRIS .A. HART

NOTICE OF THE DEATH OF

.HARRIS

SERIES A. No. 1. INTERVAL BETWEEN CARDS = 2 MINUTES.

CARDS TAKEN SIMULTANEOUSLY.

Time	Length	No. of Readings	Ave. H.P.
9:12-10:12	1 hr. 0'	30	58.49
10:12-11:12	"	30	59.50
11:12-12:12	"	23	45.65
12:12- 1:12	"	23	21.73
1:12- 2:12	"	30	58.65
2:12- 3:12	"	30	62.11
3:12 -4:12	"	28	83.79
9:12-11:12	2 hr. 0'	60	58.99
10:12-12:12	"	53	53.48
11:12 -1:12	"	46	33.69
12:12 -2:12	"	53	42.63
1:12 -3:12	"	60	60.38
2:12 -4:12	"	58	72.58
9:12-12:12	3 hrs. 0'	83	55.30
10:12 -1:12	"	76	43.88
11:12 -2:12	"	76	43.53
12:12 -3:12	"	83	49.66
1:12 -4:12	"	88	67.83
9:12 -1:12	4 hrs. 0'	106	48.01
10:12 -2:12	"	106	48.06
11:12 -3:12	"	106	48.79
12:12 -4:12	"	111	58.27
9:12 -2:12	5 hrs. 0'	136	50.36

Estimation of the Probability of a Default

Year	Sample Size	Model	Estimate
1990	100	Model 1	0.01-0.02
1991	100	"	0.02-0.03
1992	100	"	0.03-0.04
1993	100	"	0.04-0.05
1994	100	"	0.05-0.06
1995	100	"	0.06-0.07
1996	100	Model 2	0.07-0.08
1997	100	"	0.08-0.09
1998	100	"	0.09-0.10
1999	100	"	0.10-0.11
2000	100	"	0.11-0.12
2001	100	"	0.12-0.13
2002	100	Model 3	0.13-0.14
2003	100	"	0.14-0.15
2004	100	"	0.15-0.16
2005	100	"	0.16-0.17
2006	100	Model 4	0.17-0.18
2007	100	"	0.18-0.19
2008	100	"	0.19-0.20
2009	100	"	0.20-0.21
2010	100	Model 5	0.21-0.22
2011	100	"	0.22-0.23
2012	100	"	0.23-0.24
2013	100	"	0.24-0.25
2014	100	Model 6	0.25-0.26
2015	100	"	0.26-0.27
2016	100	"	0.27-0.28
2017	100	"	0.28-0.29
2018	100	Model 7	0.29-0.30
2019	100	"	0.30-0.31
2020	100	"	0.31-0.32
2021	100	"	0.32-0.33
2022	100	Model 8	0.33-0.34
2023	100	"	0.34-0.35
2024	100	"	0.35-0.36
2025	100	"	0.36-0.37
2026	100	Model 9	0.37-0.38
2027	100	"	0.38-0.39
2028	100	"	0.39-0.40
2029	100	"	0.40-0.41
2030	100	Model 10	0.41-0.42
2031	100	"	0.42-0.43
2032	100	"	0.43-0.44
2033	100	"	0.44-0.45
2034	100	Model 11	0.45-0.46
2035	100	"	0.46-0.47
2036	100	"	0.47-0.48
2037	100	"	0.48-0.49
2038	100	Model 12	0.49-0.50
2039	100	"	0.50-0.51
2040	100	"	0.51-0.52
2041	100	"	0.52-0.53
2042	100	Model 13	0.53-0.54
2043	100	"	0.54-0.55
2044	100	"	0.55-0.56
2045	100	"	0.56-0.57
2046	100	Model 14	0.57-0.58
2047	100	"	0.58-0.59
2048	100	"	0.59-0.60
2049	100	"	0.60-0.61
2050	100	Model 15	0.61-0.62
2051	100	"	0.62-0.63
2052	100	"	0.63-0.64
2053	100	"	0.64-0.65
2054	100	Model 16	0.65-0.66
2055	100	"	0.66-0.67
2056	100	"	0.67-0.68
2057	100	"	0.68-0.69
2058	100	Model 17	0.69-0.70
2059	100	"	0.70-0.71
2060	100	"	0.71-0.72
2061	100	"	0.72-0.73
2062	100	Model 18	0.73-0.74
2063	100	"	0.74-0.75
2064	100	"	0.75-0.76
2065	100	"	0.76-0.77
2066	100	Model 19	0.77-0.78
2067	100	"	0.78-0.79
2068	100	"	0.79-0.80
2069	100	"	0.80-0.81
2070	100	Model 20	0.81-0.82
2071	100	"	0.82-0.83
2072	100	"	0.83-0.84
2073	100	"	0.84-0.85
2074	100	Model 21	0.85-0.86
2075	100	"	0.86-0.87
2076	100	"	0.87-0.88
2077	100	"	0.88-0.89
2078	100	Model 22	0.89-0.90
2079	100	"	0.90-0.91
2080	100	"	0.91-0.92
2081	100	"	0.92-0.93
2082	100	Model 23	0.93-0.94
2083	100	"	0.94-0.95
2084	100	"	0.95-0.96
2085	100	"	0.96-0.97
2086	100	Model 24	0.97-0.98
2087	100	"	0.98-0.99
2088	100	"	0.99-1.00
2089	100	"	1.00-1.01
2090	100	Model 25	1.01-1.02
2091	100	"	1.02-1.03
2092	100	"	1.03-1.04
2093	100	"	1.04-1.05
2094	100	Model 26	1.05-1.06
2095	100	"	1.06-1.07
2096	100	"	1.07-1.08
2097	100	"	1.08-1.09
2098	100	Model 27	1.09-1.10
2099	100	"	1.10-1.11
2100	100	"	1.11-1.12

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
10:12 -3:12	5 hrs. 0'	136	51.16
11:12 -4:12	"	134	56.11
9:12 -3:12	6 hrs. 0'	166	52.48
10:12 -4:12	"	164	56.73
9:12 -4:12	7 hrs. 0'	194	57.01

Summary of the 1990s

Year	To	From	Notes
1990	10/1	10/1	10/1 - 10/1
1991	10/1	10/1	10/1 - 10/1
1992	10/1	10/1	10/1 - 10/1
1993	10/1	10/1	10/1 - 10/1
1994	10/1	10/1	10/1 - 10/1
1995	10/1	10/1	10/1 - 10/1
1996	10/1	10/1	10/1 - 10/1
1997	10/1	10/1	10/1 - 10/1
1998	10/1	10/1	10/1 - 10/1
1999	10/1	10/1	10/1 - 10/1
2000	10/1	10/1	10/1 - 10/1

TABLE XV.
SERIES A. NUMBER 2.
RESULTS WITH FOUR MINUTE
INTERVALS.

THE FIRST

A STORY OF A BOY

WHO WAS BORN IN THE

YEAR 1800

SERIES A. No.2.

INTERVAL BETWEEN CARDS = 4 MINUTES

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12-10:12	1 hr. 0'	15	58.24
10:12-11:12	"	15	60.25
11:12-12:12	"	13	45.41
12:12 -1:12	"	13	21.21
1:12 -2:12	"	15	58.70
2:12 -3:12	"	15	55.32
3:12 -4:12	"	14	82.97
9:12-11:12	2 hrs.0'	30	59.24
10:12-12:12	"	28	53.36
11:12 -1:12	"	26	33.31
12:12 -2:12	"	28	41.29
1:12 -3:12	"	30	57.01
2:12 -4:12	"	29	68.67
9:12-12:12	3 hrs.0'	43	55.06
10:12 -1:12	"	41	43.17
11:12 -2:12	"	41	42.60
12:12 -3:12	"	43	46.19
1:12 -4:12	"	44	65.27
9:12 -1:12	4 hrs.0'	56	47.20
10:12 -2:12	"	56	47.33
11:12 -3:12	"	56	46.01
12:12 -4:12	"	57	55.22
9:12 -2:12	5 hrs.0'	71	49.63
10:12 -3:12	"	71	49.03

TABLE 1. Summary of the data for the 1990-1991 season.

Year	Sex	Age	Weight
1990	Male	1	10.0
1990	Female	1	10.0
1990	Male	2	10.0
1990	Female	2	10.0
1990	Male	3	10.0
1990	Female	3	10.0
1990	Male	4	10.0
1990	Female	4	10.0
1990	Male	5	10.0
1990	Female	5	10.0
1990	Male	6	10.0
1990	Female	6	10.0
1990	Male	7	10.0
1990	Female	7	10.0
1990	Male	8	10.0
1990	Female	8	10.0
1990	Male	9	10.0
1990	Female	9	10.0
1990	Male	10	10.0
1990	Female	10	10.0
1990	Male	11	10.0
1990	Female	11	10.0
1990	Male	12	10.0
1990	Female	12	10.0
1990	Male	13	10.0
1990	Female	13	10.0
1990	Male	14	10.0
1990	Female	14	10.0
1990	Male	15	10.0
1990	Female	15	10.0
1990	Male	16	10.0
1990	Female	16	10.0
1990	Male	17	10.0
1990	Female	17	10.0
1990	Male	18	10.0
1990	Female	18	10.0
1990	Male	19	10.0
1990	Female	19	10.0
1990	Male	20	10.0
1990	Female	20	10.0
1990	Male	21	10.0
1990	Female	21	10.0
1990	Male	22	10.0
1990	Female	22	10.0
1990	Male	23	10.0
1990	Female	23	10.0
1990	Male	24	10.0
1990	Female	24	10.0
1990	Male	25	10.0
1990	Female	25	10.0
1990	Male	26	10.0
1990	Female	26	10.0
1990	Male	27	10.0
1990	Female	27	10.0
1990	Male	28	10.0
1990	Female	28	10.0
1990	Male	29	10.0
1990	Female	29	10.0
1990	Male	30	10.0
1990	Female	30	10.0
1990	Male	31	10.0
1990	Female	31	10.0
1990	Male	32	10.0
1990	Female	32	10.0
1990	Male	33	10.0
1990	Female	33	10.0
1990	Male	34	10.0
1990	Female	34	10.0
1990	Male	35	10.0
1990	Female	35	10.0
1990	Male	36	10.0
1990	Female	36	10.0
1990	Male	37	10.0
1990	Female	37	10.0
1990	Male	38	10.0
1990	Female	38	10.0
1990	Male	39	10.0
1990	Female	39	10.0
1990	Male	40	10.0
1990	Female	40	10.0
1990	Male	41	10.0
1990	Female	41	10.0
1990	Male	42	10.0
1990	Female	42	10.0
1990	Male	43	10.0
1990	Female	43	10.0
1990	Male	44	10.0
1990	Female	44	10.0
1990	Male	45	10.0
1990	Female	45	10.0
1990	Male	46	10.0
1990	Female	46	10.0
1990	Male	47	10.0
1990	Female	47	10.0
1990	Male	48	10.0
1990	Female	48	10.0
1990	Male	49	10.0
1990	Female	49	10.0
1990	Male	50	10.0
1990	Female	50	10.0
1990	Male	51	10.0
1990	Female	51	10.0
1990	Male	52	10.0
1990	Female	52	10.0
1990	Male	53	10.0
1990	Female	53	10.0
1990	Male	54	10.0
1990	Female	54	10.0
1990	Male	55	10.0
1990	Female	55	10.0
1990	Male	56	10.0
1990	Female	56	10.0
1990	Male	57	10.0
1990	Female	57	10.0
1990	Male	58	10.0
1990	Female	58	10.0
1990	Male	59	10.0
1990	Female	59	10.0
1990	Male	60	10.0
1990	Female	60	10.0
1990	Male	61	10.0
1990	Female	61	10.0
1990	Male	62	10.0
1990	Female	62	10.0
1990	Male	63	10.0
1990	Female	63	10.0
1990	Male	64	10.0
1990	Female	64	10.0
1990	Male	65	10.0
1990	Female	65	10.0
1990	Male	66	10.0
1990	Female	66	10.0
1990	Male	67	10.0
1990	Female	67	10.0
1990	Male	68	10.0
1990	Female	68	10.0
1990	Male	69	10.0
1990	Female	69	10.0
1990	Male	70	10.0
1990	Female	70	10.0
1990	Male	71	10.0
1990	Female	71	10.0
1990	Male	72	10.0
1990	Female	72	10.0
1990	Male	73	10.0
1990	Female	73	10.0
1990	Male	74	10.0
1990	Female	74	10.0
1990	Male	75	10.0
1990	Female	75	10.0
1990	Male	76	10.0
1990	Female	76	10.0
1990	Male	77	10.0
1990	Female	77	10.0
1990	Male	78	10.0
1990	Female	78	10.0
1990	Male	79	10.0
1990	Female	79	10.0
1990	Male	80	10.0
1990	Female	80	10.0
1990	Male	81	10.0
1990	Female	81	10.0
1990	Male	82	10.0
1990	Female	82	10.0
1990	Male	83	10.0
1990	Female	83	10.0
1990	Male	84	10.0
1990	Female	84	10.0
1990	Male	85	10.0
1990	Female	85	10.0
1990	Male	86	10.0
1990	Female	86	10.0
1990	Male	87	10.0
1990	Female	87	10.0
1990	Male	88	10.0
1990	Female	88	10.0
1990	Male	89	10.0
1990	Female	89	10.0
1990	Male	90	10.0
1990	Female	90	10.0
1990	Male	91	10.0
1990	Female	91	10.0
1990	Male	92	10.0
1990	Female	92	10.0
1990	Male	93	10.0
1990	Female	93	10.0
1990	Male	94	10.0
1990	Female	94	10.0
1990	Male	95	10.0
1990	Female	95	10.0
1990	Male	96	10.0
1990	Female	96	10.0
1990	Male	97	10.0
1990	Female	97	10.0
1990	Male	98	10.0
1990	Female	98	10.0
1990	Male	99	10.0
1990	Female	99	10.0
1990	Male	100	10.0
1990	Female	100	10.0

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
11:12 -4:12	5 hrs.0'	70	53.26
9:12 -3:12	6 hrs.0'	86	50.62
10:12 -4:12	"	85	54.61
9:12 -4:12	7 hrs.0'	100	55.15

TABLE XVI.
SERIES A. NUMBER 3.
RESULTS WITH SIX MINUTE
INTERVALS.

LIVE BAIT
J. C. HENRY J. A. DUNN
STATIONERS AND PRINTERS
J. H. HENRY

SERIES A. No.3.

INTERVAL BETWEEN CARDS = 6 MINUTES.

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12-10:12	1 hr. 0'	10	58.43
10:12-11:12	"	10	59.47
11:12-12:12	"	9	45.68
12:12 -1:12	"	10	19.89
2:12 -3:12	"	10	58.75
2:12 -3:12	"	10	62.02
3:12 -4:12	"	10	83.82
9:12-11:12	2 hrs.0'	20	58.95
10:12-12:12	"	19	52.94
11:12- 1:12	"	19	32.11
12:12 -2:12	"	20	39.32
1:12 -3:12	"	20	60.39
2:12 -4:12	"	20	72.92
9:12-12:12	3 hrs.0'	29	54.83
10:12 -1:12	"	29	41.54
11:12 -2:12	"	29	41.29
12:12 -3:12	"	30	46.89
1:12 -4:12	"	30	68.20
9:12 -1:12	4 hrs.0'	39	45.87
10:12 -2:12	"	39	45.94
11:12 -3:12	"	39	46.61
12:12 -4:12	"	40	56.12

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12 -2:12	5 hrs0'	49	48.50
10:12 -3:12	"	49	49.23
11:12 -4:12	"	49	54.20
9:12 -3:12	6 hrs.0'	59	50.79
10:12 -4:12	"	59	55.10
9:12 -4:12	7 hrs.0'	69	55.58

Year	Month	Day	Time
1911	April	1	11:00-11:15
1911	April	2	11:00-11:15
1911	April	3	11:00-11:15
1911	April	4	11:00-11:15
1911	April	5	11:00-11:15
1911	April	6	11:00-11:15
1911	April	7	11:00-11:15
1911	April	8	11:00-11:15
1911	April	9	11:00-11:15
1911	April	10	11:00-11:15
1911	April	11	11:00-11:15
1911	April	12	11:00-11:15
1911	April	13	11:00-11:15
1911	April	14	11:00-11:15
1911	April	15	11:00-11:15
1911	April	16	11:00-11:15
1911	April	17	11:00-11:15
1911	April	18	11:00-11:15
1911	April	19	11:00-11:15
1911	April	20	11:00-11:15
1911	April	21	11:00-11:15
1911	April	22	11:00-11:15
1911	April	23	11:00-11:15
1911	April	24	11:00-11:15
1911	April	25	11:00-11:15
1911	April	26	11:00-11:15
1911	April	27	11:00-11:15
1911	April	28	11:00-11:15
1911	April	29	11:00-11:15
1911	April	30	11:00-11:15

TABLE XVII.
SERIES A. NUMBER 4.
RESULTS WITH EIGHT MINUTE
INTERVALS.

TYPE SET

A. J. JONES A. J. JONES

STREET TOWN STATE COUNTRY

(LAWYER)

SERIES A. No. 4. INTERVAL BETWEEN CARDS = 8 MINUTES.

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12-10:16	1 hr. 4'	8	58.08
10:16-11:12	0 56'	7	59.86
11:12-12:16	1 " 4'	7	44.41
12:16 -1:12	0 " 56	7	20.27
1:12 -2:16	1 hr. 4'	8	59.15
2:16 -3:12	0 hr. 56'	7	60.95
3:12 -4:16	1 hr. 4'	8	86.10
9:12-11:12	2 hrs. 0'	15	58.91
10:16-12:16	"	14	52.14
11:12- 1:12	"	14	32.34
12:16 -2:16	"	15	41.01
1:12 -3:12	"	15	59.99
2:16 -4:16	"	15	74.36
9:12-12:16	3 hrs. 4'	22	54.30
10:16 -1:12	2 hrs. 56'	21	41.51
11:12 -2:16	3 hrs. 4'	22	42.09
12:16 -3:12	2 hrs. 56'	22	47.35
1:12 -4:16	3 hrs. 4'	23	69.07
9:12 -1:12	4 hrs. 0'	29	46.08
10:16 -2:16	"	29	46.38
11:12 -3:12	"	29	46.64
12:16 -4:16	"	30	57.68

Year	Age	Sex	Location
1998	10	M	1000
1999	11	F	1000
2000	12	M	1000
2001	13	F	1000
2002	14	M	1000
2003	15	F	1000
2004	16	M	1000
2005	17	F	1000
2006	18	M	1000
2007	19	F	1000
2008	20	M	1000
2009	21	F	1000
2010	22	M	1000
2011	23	F	1000
2012	24	M	1000
2013	25	F	1000
2014	26	M	1000
2015	27	F	1000
2016	28	M	1000
2017	29	F	1000
2018	30	M	1000
2019	31	F	1000
2020	32	M	1000
2021	33	F	1000
2022	34	M	1000
2023	35	F	1000
2024	36	M	1000
2025	37	F	1000
2026	38	M	1000
2027	39	F	1000
2028	40	M	1000
2029	41	F	1000
2030	42	M	1000
2031	43	F	1000
2032	44	M	1000
2033	45	F	1000
2034	46	M	1000
2035	47	F	1000
2036	48	M	1000
2037	49	F	1000
2038	50	M	1000
2039	51	F	1000
2040	52	M	1000
2041	53	F	1000
2042	54	M	1000
2043	55	F	1000
2044	56	M	1000
2045	57	F	1000
2046	58	M	1000
2047	59	F	1000
2048	60	M	1000
2049	61	F	1000
2050	62	M	1000
2051	63	F	1000
2052	64	M	1000
2053	65	F	1000
2054	66	M	1000
2055	67	F	1000
2056	68	M	1000
2057	69	F	1000
2058	70	M	1000
2059	71	F	1000
2060	72	M	1000
2061	73	F	1000
2062	74	M	1000
2063	75	F	1000
2064	76	M	1000
2065	77	F	1000
2066	78	M	1000
2067	79	F	1000
2068	80	M	1000
2069	81	F	1000
2070	82	M	1000
2071	83	F	1000
2072	84	M	1000
2073	85	F	1000
2074	86	M	1000
2075	87	F	1000
2076	88	M	1000
2077	89	F	1000
2078	90	M	1000
2079	91	F	1000
2080	92	M	1000
2081	93	F	1000
2082	94	M	1000
2083	95	F	1000
2084	96	M	1000
2085	97	F	1000
2086	98	M	1000
2087	99	F	1000
2088	100	M	1000
2089	101	F	1000
2090	102	M	1000
2091	103	F	1000
2092	104	M	1000
2093	105	F	1000
2094	106	M	1000
2095	107	F	1000
2096	108</		

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12 -2:16	5 hrs. 4'	37	48.91
10:16 -3:12	4 hrs. 56'	36	49.21
11:12 -4:16	5 hrs. 4'	37	55.17
9:12 -3:12	6 hrs. 0'	44	50.82
10:16 -4:16	6 hrs. 0'	44	55.92
9:12 -4:16	7 hrs. 4'	52	56.25

TABLE XVIII.
SERIES A. NUMBER 5.
RESULT WITH TEN MINUTE
INTERVALS.

3159 PLUMMER

SERIES A. No.5.

INTERVAL BETWEEN CARDS = 10 MINUTES.

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12-10:12	1 hr.	6	58.88
10:12-11:12	"	6	58.84
11:12-12:12	"	5	46.27
12:12 -1:12	"	6	19.71
1:12 -2:12	"	6	59.61
2:12 -3:12	"	6	63.44
3:12 -4:12	"	6	83.51
9:12-11:12	2 hrs.	12	58.86
10:12-12:12	"	11	53.13
11:12 -1:12	"	11	31.78
12:12 -2:12	"	12	39.66
1:12 -3:12	"	12	61.53
2:12 -4:12	"	12	73.48
9:12-12:12	3 hrs.	17	55.16
10:12 -1:12	"	17	41.33
11:12 -2:12	"	17	41.60
12:12 -3:12	"	18	47.59
1:12 -4:12	"	18	68.86
9:12 -1:12	4 hrs.	23	45.91
10:12 -2:12	"	23	46.10
11:12 -3:12	"	23	47.30
12:12 -4:12	"	24	56.57

SECTION 12 - 1994-1995

Year	Age	Class	Rate
1994	Age	Class	Rate
1994	1	1st	11:00-11:15
1994	2	2nd	11:15-11:30
1994	3	3rd	11:30-11:45
1994	4	4th	11:45-12:00
1994	5	5th	12:00-12:15
1994	6	6th	12:15-12:30
1994	7	7th	12:30-12:45
1994	8	8th	12:45-13:00
1994	9	9th	13:00-13:15
1994	10	10th	13:15-13:30
1994	11	11th	13:30-13:45
1994	12	12th	13:45-14:00
1994	13	13th	14:00-14:15
1994	14	14th	14:15-14:30
1994	15	15th	14:30-14:45
1994	16	16th	14:45-15:00
1994	17	17th	15:00-15:15
1994	18	18th	15:15-15:30
1994	19	19th	15:30-15:45
1994	20	20th	15:45-16:00
1994	21	21st	16:00-16:15
1994	22	22nd	16:15-16:30
1994	23	23rd	16:30-16:45
1994	24	24th	16:45-17:00
1994	25	25th	17:00-17:15
1994	26	26th	17:15-17:30
1994	27	27th	17:30-17:45
1994	28	28th	17:45-18:00
1994	29	29th	18:00-18:15
1994	30	30th	18:15-18:30
1994	31	31st	18:30-18:45
1994	32	32nd	18:45-19:00
1994	33	33rd	19:00-19:15
1994	34	34th	19:15-19:30
1994	35	35th	19:30-19:45
1994	36	36th	19:45-20:00
1994	37	37th	20:00-20:15
1994	38	38th	20:15-20:30
1994	39	39th	20:30-20:45
1994	40	40th	20:45-21:00
1994	41	41st	21:00-21:15
1994	42	42nd	21:15-21:30
1994	43	43rd	21:30-21:45
1994	44	44th	21:45-22:00
1994	45	45th	22:00-22:15
1994	46	46th	22:15-22:30
1994	47	47th	22:30-22:45
1994	48	48th	22:45-23:00
1994	49	49th	23:00-23:15
1994	50	50th	23:15-23:30
1994	51	51st	23:30-23:45
1994	52	52nd	23:45-24:00
1994	53	53rd	24:00-24:15
1994	54	54th	24:15-24:30
1994	55	55th	24:30-24:45
1994	56	56th	24:45-25:00
1994	57	57th	25:00-25:15
1994	58	58th	25:15-25:30
1994	59	59th	25:30-25:45
1994	60	60th	25:45-26:00
1994	61	61st	26:00-26:15
1994	62	62nd	26:15-26:30
1994	63	63rd	26:30-26:45
1994	64	64th	26:45-27:00
1994	65	65th	27:00-27:15
1994	66	66th	27:15-27:30
1994	67	67th	27:30-27:45
1994	68	68th	27:45-28:00
1994	69	69th	28:00-28:15
1994	70	70th	28:15-28:30
1994	71	71st	28:30-28:45
1994	72	72nd	28:45-29:00
1994	73	73rd	29:00-29:15
1994	74	74th	29:15-29:30
1994	75	75th	29:30-29:45
1994	76	76th	29:45-30:00
1994	77	77th	30:00-30:15
1994	78	78th	30:15-30:30
1994	79	79th	30:30-30:45
1994	80	80th	30:45-31:00
1994	81	81st	31:00-31:15
1994	82	82nd	31:15-31:30
1994	83	83rd	31:30-31:45
1994	84	84th	31:45-32:00
1994	85	85th	32:00-32:15
1994	86	86th	32:15-32:30
1994	87	87th	32:30-32:45
1994	88	88th	32:45-33:00
1994	89	89th	33:00-33:15
1994	90	90th	33:15-33:30
1994	91	91st	33:30-33:45
1994	92	92nd	33:45-34:00
1994	93	93rd	34:00-34:15
1994	94	94th	34:15-34:30
1994	95	95th	34:30-34:45
1994	96	96th	34:45-35:00
1994	97	97th	35:00-35:15
1994	98	98th	35:15-35:30
1994	99	99th	35:30-35:45
1994	100	100th	35:45-36:00

CARDS TAKEN SIMULTANEOUSLY.

Time	Length of Test	No. of Readings	Ave. I.H.P.
9:12 -2:12	5 hrs.	29	48.74
10:12 -3:12	"	29	49.69
11:12 -4:12	"	29	54.80
9:12 -3:12	6 hrs.	35	51.29
10:12 -4:12	"	35	55.49
9:12 -4:12	7 hrs.	41	55.98

Summary of Project Status Report

Area	Project	Status	Notes
1.1.1	Project A	On Track	2023-10-15
1.1.2	Project B	At Risk	2023-10-15
1.1.3	Project C	Completed	2023-10-15
1.2.1	Project D	On Track	2023-10-15
1.2.2	Project E	At Risk	2023-10-15
1.2.3	Project F	Completed	2023-10-15

SERIES B.

EFFECT ON THE RESULT FOR AVERAGE HORSE POWER
OF THE METHOD OF TAKING CARDS.

18 1818

RECEIVED FROM THE OFFICE OF THE SECRETARY OF THE ARMY

THE FOLLOWING REPORT OF THE COMMISSIONER OF THE GENERAL LAND OFFICE

TABLE XIX.
SERIES B NUMBER 1.
RESULTS WITH TWO MINUTE
INTERVALS.

THE
OF THE
THE
THE

SERIES B. No.1. INTERVAL BETWEEN CARDS = 2 MINUTES

CARDS TAKEN SIMULTANEOUSLY.

CARDS TAKEN IN ROTATION.

Time	Length of Test Hrs. Min.	No. of Readings	Ave. I.H.P.	Time	Length of Test Hrs. Min.	No. of Readings	Ave. I.H.P.
9:12-10:16	1 - 4	32	58.60	9:12-10:16	1 - 4	8	58.90
10:16-11:12	0 - 56	28	59.09	10:16-11:12	0 - 56	7	59.47
11:12-12:14	1 - 2	28	44.42	11:12-12:14	1 - 2	6	44.34
12:14 -1:16	1 - 2	24	25.56	12:14 -1:16	1 - 2	6	26.75
1:16 -2:12	0 - 56	28	58.17	1:16 -2:12	0 - 56	7	58.29
2:12 -3:14	1 - 2	31	62.42	2:12 -3:14	1 - 2	8	63.12
3:14 -4:16	1 - 2	29	85.33	3:14 -4:16	1 - 2	7	84.79
9:12-11:12	2 - 0	60	58.82	9:12-11:12	2 - 0	15	59.16
10:16-12:14	1 - 58	56	48.60	10:16-12:14	1 - 58	13	52.18
11:12 -1:16	2 - 4	52	32.32	11:12 -1:16	2 - 4	12	35.54
12:14 -2:12	1 - 58	52	43.12	12:14 -2:12	1 - 58	13	43.73
1:16 -3:14	1 - 58	59	60.40	1:16 -3:14	1 - 58	15	60.87
2:12 -4:16	2 - 4	60	73.49	2:12 -4:16	2 - 4	15	73.22
9:12-12:12	3 - 0	88	52.23	9:12-12:14	3 - 2	21	54.93
10:16 -1:16	3 - 0	80	41.69	10:16 -1:16	3 - 0	19	44.36
11:12 -2:12	3 - 0	80	41.37	11:12 -2:12	3 - 0	19	43.92
12:14 -3:14	3 - 0	83	50.33	12:14 -3:14	3 - 0	21	51.12
1:16 -4:16	3 - 0	88	68.84	1:16 -4:16	3 - 0	22	68.48
9:12 -1:16	4 - 4	112	46.52	9:12 -1:16	4 - 4	27	48.67
10:16 -2:12	3 - 56	108	45.96	10:16 -2:12	3 - 56	26	48.11
11:12 -3:14	4 - 2	111	47.25	11:12 -3:14	4 - 2	27	49.61

CARDS TAKEN SIMULTANEOUSLY.

	Length	No.of	Ave.
Time of Test	Readings	I.H.P.	
Hrs. Min.			
12:14 -4:16 4 - 2	112	59.39	
9:12 -2:12 5 - 0	140	48.85	
10:16 -3:14 4 -58	139	49.64	
11:12 -4:16 5 - 4	140	55.13	

CARDS TAKEN IN ROTATION

	Length	No.of	Ave.
Time of Test	Readings	I.H.P.	
Hrs. Min.			
12:14 -4:16 4 - 2	28	59.53	
9:12 -2:12 5 -0	34	50.64	
10:16 -3:14 4 -58	34	51.64	
11:12 -4:16 5 - 4	34	56.85	
9:12 -3:14 6 - 2	42	53.02	
10:16 -4:16 6 - 0	41	57.30	
9:12 -4:16 7 - 4	49	57.56	

12.00 423 20-9 3436- 44:00

870. 960 970- 980- 990- 1000-

[illegible]

TABLE XX.
SERIES B. NUMBER 2.
RESULTS WITH FOUR MINUTE
INTERVALS.

• 2010 年 12 月 22 日

SERIES B. NO.2.

INTERVAL BETWEEN CARDS = 4 MINUTES.

CARDS TAKEN SIMULTANEOUSLY.

CARDS TAKEN IN ROTATION.

Time	Length of Test Hrs. Min.	No.of Readings	Ave. I.H.P.	Time	Length of Test Hrs. Min.	No.of Readings	Ave. I.H.P.
9:12-10:16	1 - 4	16	58.29	9:12-10:16	1 - 4	4	58.18
10:16-11:20	1 - 4	16	60.00	10:16-11:20	1 - 4	4	59.45
11:20-12:12	0 - 52	11	43.78	11:20-12:12	0 - 52	3	43.39
12:12 -1:08	0 - 56	12	19.44	12:12 -1:08	0 - 56	3	19.35
1:08 -2:12	1 - 4	16	57.68	1:08 -2:12	1 - 4	4	57.38
2:12 -3:16	1 - 4	16	62.46	2:12 -3:16	1 - 4	4	62.43
3:16 -4:04	0 - 48	12	33.14	3:16 -4:04	0 - 48	3	84.13
9:12-11:20	2 - 8	32	58.94	9:12-11:20	2 - 8	8	58.81
10:16-12:12	1 - 56	27	53.15	10:16-12:12	1 - 56	7	52.65
11:20 -1:08	1 - 48	23	31.08	11:20 -1:08	1 - 48	6	31.47
12:12 -2:12	2 - 0	28	41.29	12:12 -2:12	2 - 0	7	39.65
1:08 -3:16	2 - 8	32	60.07	1:08 -3:16	2 - 8	8	59.91
2:12 -4:04	1 - 52	28	71.32	2:12 -4:04	1 - 52	7	71.73
9:12-12:12	3 - 0	43	55.06	9:12-12:12	3 - 0	11	54.66
10:16 -1:08	2 - 52	39	42.78	10:16 -1:08	2 - 52	10	42.48
11:20 -2:12	2 - 52	39	41.99	11:20 -2:12	2 - 52	10	41.66
12:12 -3:16	3 - 4	44	48.76	12:12 -3:16	3 - 4	11	47.94
1:08 -4:04	2 - 56	44	66.36	1:08 -4:04	2 - 56	11	66.51
9:12 -1:08	3 - 56	55	47.29	9:12 -1:08	3 - 56	14	47.10
10:16 -2:12	3 - 56	55	47.11	10:16 -2:12	3 - 56	14	46.87
11:20 -3:16	3 - 56	55	47.95	11:20 -3:16	3 - 56	14	47.72

Regression Analysis Results

Regression Analysis Results

Year	Model	Adjusted R-Square	F-Statistic	Year	Model	Adjusted R-Square	F-Statistic
2000	1	0.0000	0.0000	2000	1	0.0000	0.0000
2001	1	0.0000	0.0000	2001	1	0.0000	0.0000
2002	1	0.0000	0.0000	2002	1	0.0000	0.0000
2003	1	0.0000	0.0000	2003	1	0.0000	0.0000
2004	1	0.0000	0.0000	2004	1	0.0000	0.0000
2005	1	0.0000	0.0000	2005	1	0.0000	0.0000
2006	1	0.0000	0.0000	2006	1	0.0000	0.0000
2007	1	0.0000	0.0000	2007	1	0.0000	0.0000
2008	1	0.0000	0.0000	2008	1	0.0000	0.0000
2009	1	0.0000	0.0000	2009	1	0.0000	0.0000
2010	1	0.0000	0.0000	2010	1	0.0000	0.0000
2011	1	0.0000	0.0000	2011	1	0.0000	0.0000
2012	1	0.0000	0.0000	2012	1	0.0000	0.0000
2013	1	0.0000	0.0000	2013	1	0.0000	0.0000
2014	1	0.0000	0.0000	2014	1	0.0000	0.0000
2015	1	0.0000	0.0000	2015	1	0.0000	0.0000
2016	1	0.0000	0.0000	2016	1	0.0000	0.0000
2017	1	0.0000	0.0000	2017	1	0.0000	0.0000
2018	1	0.0000	0.0000	2018	1	0.0000	0.0000
2019	1	0.0000	0.0000	2019	1	0.0000	0.0000
2020	1	0.0000	0.0000	2020	1	0.0000	0.0000
2021	1	0.0000	0.0000	2021	1	0.0000	0.0000
2022	1	0.0000	0.0000	2022	1	0.0000	0.0000
2023	1	0.0000	0.0000	2023	1	0.0000	0.0000
2024	1	0.0000	0.0000	2024	1	0.0000	0.0000
2025	1	0.0000	0.0000	2025	1	0.0000	0.0000
2026	1	0.0000	0.0000	2026	1	0.0000	0.0000
2027	1	0.0000	0.0000	2027	1	0.0000	0.0000
2028	1	0.0000	0.0000	2028	1	0.0000	0.0000
2029	1	0.0000	0.0000	2029	1	0.0000	0.0000
2030	1	0.0000	0.0000	2030	1	0.0000	0.0000

CARDS TAKEN SIMULTANEOUSLY.

	Length	No.of	Ave.
Time	of Test	Readings	I.H.P.
	Hrs.	Min.	

12:12	-4:04	3 -52	56 56.31
-------	-------	-------	----------

9:12	-2:12	5 - 0	71 49.63
------	-------	-------	----------

10:16	-3:16	5 - 0	71 50.57
-------	-------	-------	----------

11:20	-4:04	4 -44	67 54.25
-------	-------	-------	----------

9:12	-3:16	6 - 4	87 51.99
------	-------	-------	----------

10:16	-4:04	5 -48	83 55.28
-------	-------	-------	----------

9:12	-4:04	6 -52	99 55.77
------	-------	-------	----------

CARDS TAKEN IN ROTATION.

	Length	No.of	Ave.
Time	of Test	Readings	I.H.P.
	Hrs.	Min.	

12:12	-4:04	3 -52	14 55.69
-------	-------	-------	----------

9:12	-2:12	5 - 0	18 48.70
------	-------	-------	----------

10:16	-3:16	5 - 0	18 49.66
-------	-------	-------	----------

11:20	-4:04	4 -44	17 53.40
-------	-------	-------	----------

9:12	-3:16	6 - 4	22 51.76
------	-------	-------	----------

10:16	-4:04	5 -48	21 55.24
-------	-------	-------	----------

9:12	-4:04	6 -52	25 55.66
------	-------	-------	----------

TABLE XXI.
SERIES B. NUMBER 3.
RESULTS WITH SIX MINUTE
INTERVALS.

VIEW NO. 17
2 1880-18 10 1810-18
STREET 100 100 100 100
100 100 100 100

SERIES No.3.

INTERVAL BETWEEN CARDS = 6 MINUTES

CARDS TAKEN SIMULTANEOUSLY.

CARDS TAKEN IN ROTATION.

Length No.of Ave.				Length No.of Ave.			
Time	of Tests	Readings	I.H.P.	Time	of Test	Readings	I.H.P.
Hrs. Min.				Hrs. Min.			
9:12-10:00	0 -48	8	58.22	9:12-10:00	0 -48	2	56.40
10:00-11:12	1 -12	12	59.44	10:00-11:12	1 -12	3	58.96
11:12-12:06	0 -54	8	49.04	11:12-12:06	0 -54	2	50.46
12:06 -1:18	1 -12	12	23.45	12:06 -1:18	1 -12	3	22.34
1:18 -2:30	1 -12	12	57.68	1:18 -2:30	1 -12	3	58.59
2:30 -3:18	0 -48	8	65.32	2:30 -3:18	0 -48	2	64.40
3:18 -4:06	0 -48	8	84.02	3:18 -4:06	0 -48	2	82.84
9:12-11:12	2 - 0	20	58.95	9:12-11:12	2 - 0	5	57.94
10:00-12:06	2 - 6	20	55.28	10:00-12:06	2 - 6	5	55.56
11:12 -1:18	2 - 6	20	33.68	11:12 -1:18	2 - 6	5	33.59
12:06 -2:30	2 -24	24	40.56	12:06 -2:30	2 -24	6	40.63
1:18 -3:18	2 - 0	20	60.74	1:18 -3:18	2 - 0	5	61.11
2:30 -4:06	1 -36	16	74.67	2:30 -4:06	1 -36	4	73.62
9:12-12:06	2 -54	28	56.12	9:12-12:06	2 -54	7	55.80
10:00 -1:18	3 -18	32	43.34	10:00 -1:18	3 -18	8	43:10
11:12 -2:30	3 -18	32	42.68	11:12 -2:30	3 -18	8	43.09
12:06 -3:18	3 -12	32	46.75	12:06 -3:18	3 -12	8	46.57
1:18 -4:06	2 -48	28	67.39	1:18 -4:06	2 -48	7	67.32
9:12 -1:18	4 - 6	40	46.32	9:12 -1:18	4 - 6	10	45.76
10:00 -2:30	4 -30	44	47.25	10:00 -2:30	4 -30	11	47.43
11:12 -3:18	4 - 6	40	47.21	11:12 -3:18	4 - 6	10	47.35

CARDS TAKEN SIMULTANEOUSLY.

	Length	No.of	Ave.	
Time	of Test	Readings	I.H.P.	
	Hrs. Min.			
12:06	-4:06 4 - 0	40	54.21	
9:12	-2:30 5 -18	52	48.94	
10:00	-3:18 5 -18	52	50.03	
11:12	-4:06 4 -54	48	53.35	
9:12	-3:18 6 - 6	60	51.12	
10:00	-4:06 6 - 6	60	54.56	
9:12	-4:06 6 -54	68	54.99	

CARDS TAKEN IN ROTATION.

	Length	No.of	Ave.	
Time	of Test	Readings	I.H.P.	
	Hrs. Min.			
12:06	-4:06 4 - 0	10	53.83	
9:12	-2:30 5 -18	13	48.80	
10:00	-3:18 5 -18	13	50.03	
11:12	-4:06 4 -54	12	53.27	
9:12	-3:18 6 - 6	15	50.88	
10:00	-4:0 <u>6</u> 6 - 6	15	54.40	
9:12	-4:06 6 -54	17	54.64	

TABLE XXII.

SERIES B. NUMBER 4.
RESULTS WITH EIGHT MINUTE
INTERVALS.

THE KING
A. B. C. D. E. F. G. H. I. J. K. L. M. N. O. P. Q. R. S. T. U. V. W. X. Y. Z.
STANDARD TIME 12:00 PM
12:00 PM

SERIES B. No. 4. INTERVAL BETWEEN CARDS = 8 MINUTES.

CARDS TAKEN SIMULTANEOUSLY.

CARDS TAKEN IN ROTATION.

Length No.of Ave.				Length No.of Ave.			
Time	of Test	Readings	I.H.P.	Time	of Test	Readings	I.H.P.
	Hrs. Min.				Hrs. Min.		
9:12-10:24	1 -12	9	58.10	9:12-10:24	1 -12	2	56.81
10:24-11:28	1 - 4	8	59.91	10:24-11:28	1 - 4	2	57.41
11:28-12:08	0 -40	4	43.41	11:28-12:08	0 -40	1	46.31
12:08 -1:12	1 - 4	8	20.07	12:08 -1:12	1 - 4	2	19.20
1:12 -2:16	1 - 4	8	59.15	1:12 -2:16	1 - 4	2	57.28
2:16 -3:20	1 - 4	8	62.30	2:16 -3:20	1 - 4	2	62.04
3:20 -4:24	1 - 4	8	89.79	3:20 -4:20	1 - 0	2	97.06
9:12-11:28	2 -16	17	58.95	9:12-11:28	2 -16	4	57.11
10:24-12:08	1 -44	12	54.41	10:24-12:08	1 -44	3	55.71
11:28 -1:12	1 -44	12	27.85	11:28 -1:12	1 -44	3	28.24
12:08 -2:16	2 - 8	16	39.61	12:08 -2:16	2 - 8	4	38.24
1:12 -3:20	2 - 8	16	60.73	1:12 -3:20	2 - 8	4	59.66
2:16 -4:24	2 - 8	16	76.04	2:16 -4:20	2 - 4	4	76.40
9:12-12:08	2 -56	21	55.99	9:12-12:08	2 -56	5	54.95
10:24 -1:12	2 -48	20	40.68	10:24 -1:12	2 -48	5	39.91
11:28 -2:16	2 -48	20	40.37	11:28 -2:16	2 -48	5	39.85
12:08 -3:20	3 -12	24	47.17	12:08 -3:20	3 -12	6	46.17
1:12 -4:24	3 -12	24	70.41	1:12 -4:20	3 - 8	6	70.03
9:12 -1:12	4 - 0	29	46.08	9:12 -1:12	4 - 0	7	44.71
10:24 -2:16	3 -52	28	45.99	10:24 -2:16	3 -52	7	44.87
11:28 -3:20	3 -52	28	46.64	11:28 -3:20	3 -52	7	46.19
12:08 -4:24	4 -16	28	66.08	12:08 -4:20	4 -12	8	57.32

CARDS TAKEN SIMULTANEOUSLY.

	Length	No.of		Ave.
Time	of Test	Readings	I.H.P.	
	Hrs. Min.			
9:12	-2:16 5 - 4	37	48.91	
10:24	-3:20 4 -56	36	49.59	
11:28	-4:24 4 -56	36	55.95	
9:12	-3:20 6 -8	45	51.29	
10:24	-4:24 6 - 0	44	56.89	
9:12	-4:24 7 -12	53	57.10	

CARDS TAKEN IN ROTATION.

	Length	No.of		Ave.
Time	of Test	Readings	I.H.P.	
	Hrs. Min.			
9:12	-2:16 5 - 4	9	47.53	
10:24	-3:20 4 -56	9	48.69	
11:28	-4:20 4 -52	9	56.10	
9:12	-3:20 6 - 8	11	50.17	
10:24	-4:20 5 -56	11	56.34	
9:12	-4:20 7 - 8	13	56.41	

RECEIVED BY MAIL - 1957

DATE	TIME	REPORT
11.11.57	0	0 - 2 01:00 - 01:01
11.11.57	1	01 - 1 00:00 - 00:01
11.11.57	2	02 - 1 00:00 - 00:01
11.11.57	11	0 - 1 00:00 - 00:01
11.11.57	11	01 - 1 00:00 - 00:01
11.11.57	11	0 - 1 00:00 - 00:01

RECEIVED BY MAIL - 1957

DATE	TIME	REPORT
11.11.57	0	0 - 2 01:00 - 01:01
11.11.57	1	01 - 1 00:00 - 00:01
11.11.57	2	02 - 1 00:00 - 00:01
11.11.57	11	0 - 1 00:00 - 00:01
11.11.57	11	01 - 1 00:00 - 00:01
11.11.57	11	0 - 1 00:00 - 00:01

TABLE XXIII.
SERIES B. NUMBER 5.
RESULTS WITH TEN MINUTE
INTERVALS.

THEY WERE
A PART OF THE
WORLD OF THE
CIVILIZATION

SERIES B. No.5.

INTERVAL BETWEEN CARDS = 10 MINUTES

CARDS TAKEN SIMULTANEOUSLY.

CARDS TAKEN IN ROTATION.

Length No.of Ave.				Length No.of Ave.			
Time	of Test	Readings	I.H.P.	Time	of Test	Readings	I.H.P.
Hrs.	Min.			Hrs.	Min.		
9:12	-2:32 1 -20	8	58.99	9:12-10:32 1 -20	2	58.82	
10:32	-11:12 0 -40	4	58.60	10:32-11:12 0 -40	1	58.57	
11:12	-12:32 1 -20	7	38.32	11:12-12:32 1 -20	2	40.93	
12:32	-1:12 0 -40	4	20.35	12:32 -1:12 0 -40	1	20.55	
1:12	-2:32 1 -20	8	59.46	1:12 -2:32 1 -20	2	58.36	
2:32	-3:12 0 -40	4	65.69	2:32 -3:12 0 -40	1	65.94	
3:12	-4:32 1 -20	8	89.15	3:12 -4:32 1 -20	2	86.83	
9:12	-11:12 2 - 0	12	58.86	9:12-11:12 2 - 0	3	58.74	
10:32	-12:32 2 - 0	11	45.69	10:32-12:32 2 - 0	3	46.81	
11:12	-1:12 2 - 0	11	31.78	11:12 -1:12 2 - 0	3	34.14	
12:32	-2:32 2 - 0	12	46.41	12:32 -2:32 2 - 0	3	45.76	
1:12	-3:12 2 - 0	12	61.53	1:12 -3:12 2 - 0	3	60.89	
2:32	-4:32 2 - 0	12	81.33	2:32 -4:32 2 - 0	3	79.87	
9:12	-12:32 3 -20	19	51.29	9:12-12:32 3 -20	5	51.61	
10:32	-1:12 2 -40	15	38.93	10:32 -1:12 2 -40	4	39.25	
11:12	-2:32 3 -20	19	43.43	11:12 -2:32 3 -20	5	43.83	
12:32	-3:12 2 -40	16	51.23	12:32 -3:12 2 -40	4	50.80	
1:12	-4:32 3 -20	20	72.58	1:12 -4:32 3 -20	5	71.26	
9:12	-1:12 4 - 0	23	45.91	9:12 -1:12 4 - 0	6	46.44	
10:32	-2:32 4 - 0	23	46.07	10:32 -2:32 4 - 0	6	46.28	
11:12	-3:12 4 - 0	23	47.30	11:12 -3:12 4 - 0	6	47.51	
12:32	-4:32 4 - 0	24	63.87	12:32 -4:32 4 - 0	6	62.93	

CARDS TAKEN SIMULTANEOUSLY TAKEN.

Time	Length of Test Hrs. Min.	No. of Readings	Ave. I.H.P.
9:12	-2:32 5 -20	31	49.40
10:32	-3:12 4 -40	27	48.98
11:12	-4:32 5 -20	31	58.10
9:12	-3:12 6 - 0	35	51.27
10:32	-4:32 6 - 0	35	58.16
9:12	-4:32 7 -20	43	58.31

CARDS TAKEN IN ROTATION.

Time	Length of Test Hrs. Min.	No. of Readings	Ave. I.H.P.
9:12	-2:32 5 -20	8	49.32
10:32	-3:12 4 -40	7	49.09
11:12	-4:32 5 -20	8	57.34
9:12	-3:12 6 - 0	9	51.25
10:32	-4:32 6 - 0	9	57.47
9:12	-4:32 7 -20	11	57.72

TABLES XXIV AND XXIV A.
VARIATION OF AVERAGE INDICATED HORSE POWER
DUE TO
CHANGE OF INTERVAL.

A VERY OLD BOOK
FROM THE LIBRARY OF THE
OTW
PRESENTED TO THE
LIBRARY OF THE

EFFECT ON RESULT OF TIME BETWEEN READINGS.

CARDS TAKEN SIMULTANEOUSLY.

TABLE 24

FROM SERIES A.

No. of Tests	Ave. Length of Tests Hrs. Min.	Average I.H.P. for Various Intervals.				
		2 Min.	4 Min.	6 Min.	8 Min.	10 Min.
7	1 - 0	55.70	54.73	55.58	55.55	55.75
6	2 - 0	53.63	52.15	52.77	53.13	53.07
5	3 - 0	52.04	50.06	50.55	50.86	50.91
4	4 - 0	50.78	48.94	48.64	49.20	48.97
3	5 - 0	52.54	50.64	50.64	51.10	51.08
2	6 - 0	54.61	52.62	52.95	53.37	53.39
1	7 - 0	57.01	55.15	55.58	56.25	55.98

TABLE 24 A.

FROM TABLE 24.

Variation of Average I.H.P. Due to Change

No. of Tests	Ave. Length of Tests Hrs. Min.	of Interval.				
		2 Min.	4 Min.	6 Min.	8 Min.	10 Min.
7	1 - 0	1.000	.982	.997	.997	1.001
6	2 - 0	1.000	.972	.984	.991	.989
5	3 - 0	1.000	.962	.971	.977	.978
4	4 - 0	1.000	.964	.958	.969	.964
3	5 - 0	1.000	.968	.968	.973	.972
2	6 - 0	1.000	.964	.969	.977	.977
1	7 - 0	1.000	.967	.975	.987	.982

TABLE 1. THERMAL STATE OF THE OCEAN

STATION DATA				THERMAL STATE	
Station No.	Latitude	Longitude	Depth, m	Temperature, °C	Year
1001	40° 00' N	10° 00' W	1000	10.00	1
1002	40° 00' N	10° 00' W	1000	10.00	2
1003	40° 00' N	10° 00' W	1000	10.00	3
1004	40° 00' N	10° 00' W	1000	10.00	4
1005	40° 00' N	10° 00' W	1000	10.00	5
1006	40° 00' N	10° 00' W	1000	10.00	6
1007	40° 00' N	10° 00' W	1000	10.00	7
1008	40° 00' N	10° 00' W	1000	10.00	8
1009	40° 00' N	10° 00' W	1000	10.00	9
1010	40° 00' N	10° 00' W	1000	10.00	10

Station No.

Year

Station No. 1001-1010

STATION DATA				THERMAL STATE	
Station No.	Latitude	Longitude	Depth, m	Temperature, °C	Year
1011	40° 00' N	10° 00' W	1000	10.00	1
1012	40° 00' N	10° 00' W	1000	10.00	2
1013	40° 00' N	10° 00' W	1000	10.00	3
1014	40° 00' N	10° 00' W	1000	10.00	4
1015	40° 00' N	10° 00' W	1000	10.00	5
1016	40° 00' N	10° 00' W	1000	10.00	6
1017	40° 00' N	10° 00' W	1000	10.00	7
1018	40° 00' N	10° 00' W	1000	10.00	8
1019	40° 00' N	10° 00' W	1000	10.00	9
1020	40° 00' N	10° 00' W	1000	10.00	10

TABLES XXV AND XXV A.
VARIATION OF AVERAGE INDICATED HORSE POWER
DUE TO
CHANGE IN THE METHOD
OF TAKING CARDS.

THE UNITED STATES OF AMERICA
DEPARTMENT OF THE ARMY
OFFICE OF THE ADJUTANT GENERAL
WASHINGTON, D. C.
OFFICE OF THE ADJUTANT GENERAL
WASHINGTON, D. C.
OFFICE OF THE ADJUTANT GENERAL
WASHINGTON, D. C.

EFFECT ON RESULT OF THE METHOD OF TAKING CARDS.

TABLE 25.

FROM SERIES B.

No. of Tests	Average I.H.P. Cards Taken Simultaneously. Interval as Shown Below.					Average I.H.P. Cards Taken in Rotation. Interval as Shown Below.				
	2 Min.	4 Min.	6 Min.	8 Min.	10 Min.	2 Min.	4 Min.	6 Min.	8 Min.	10 Min.
7	56.23	54.97	56.73	56.10	55.79	56.52	54.90	56.27	55.69	55.71
6	51.13	52.64	53.98	52.93	54.27	54.15	52.37	53.74	52.56	54.37
5	50.89	50.59	51.26	50.92	51.49	52.56	50.65	51.18	50.18	51.35
4	49.78	49.67	48.75	51.20	50.79	51.48	49.35	48.59	48.27	50.79
3	51.14	51.48	50.77	51.48	52.16	53.04	50.59	50.70	50.77	51.92
2	53.56	53.64	52.84	54.09	54.72	55.16	53.50	52.64	53.26	54.36
1	56.24	55.77	54.99	57.10	58.31	57.56	55.66	54.64	56.41	57.72

TABLE 25 A.

FROM TABLE 25.

Variation of Average I.H.P. Due to Change in the Method of Taking Cards.

No. of Tests	Int. = 2'		Int. = 4'		Int. = 6'		Int. = 8'		Int. = 10'	
	Simul.	Rot.	Simul.	Rot.	Simul.	Rot.	Simul.	Rot.	Simul.	Rot.
7	1.000	1.005	1.000	.998	1.000	.991	1.000	.992	1.000	.998
6	1.000	1.058	1.000	.994	1.000	.995	1.000	.992	1.000	1.002
5	1.000	1.032	1.000	1.001	1.000	.998	1.000	.985	1.000	.997
4	1.000	1.034	1.000	.993	1.000	.997	1.000	.942	1.000	1.000
3	1.000	1.037	1.000	.982	1.000	.998	1.000	.986	1.000	.995
2	1.000	1.029	1.000	.997	1.000	.996	1.000	.985	1.000	.993
1	1.000	1.023	1.000	.998	1.000	.993	1.000	.987	1.000	.989

NOTE- In each group there is a difference in the length of tests for change of interval. (See Series B) In all cases, however, the tests with 2, 4, 6, 8 and 10 minute intervals are of equal length and between the same hours, both when the cards are taken simultaneously and when they are taken in rotation.

[illegible]

LA. STATE RECORDS

Wavelength of maximum I.M.R. has no change in the World.

• *Wiederholungsfragen*

[illegible]

100- In some groups there is a difference in the length of teeth
between the upper and lower jaws. (See Figure 1) In all cases, however, the lower
teeth are longer than the upper teeth. (See Figure 2) A and B show the lower teeth
of a group of fish. C and D show the upper teeth of a group of fish. E and F
show the lower teeth of a group of fish. G and H show the upper teeth of a group of fish.

TESTS OF A CONTINUOUS STEAM ENGINE INDICATOR.

RESEARCH IN THE HISTORY OF THE UNITED STATES

TESTS OF A CONTINUOUS STEAM ENGINE INDICATOR.

As has been stated, the original scheme for testing the continuous indicator provided for a comparison of the results for average horse power obtained by its use with the result obtained by working up a set of cards taken at intervals, and accepting the average horse power obtained from them as the true average horse power developed by the engine.

The 8" x 12" Meyer Automatic Engine in the laboratory of the University of Illinois was chosen for use in connection with this work and was accordingly rigged up for a test. The manner in which the engine was rigged up is clearly shown in figures seven and eight.

*Figure 7*

As the new year begins, the American Medical Association is proud to present to its members a new and improved Journal. The Journal has been completely reorganized and is now published in a new format. The new format is designed to make the Journal more readable and more useful to its readers. The new format includes a new table of contents, a new index, and a new section on "Medical Progress." The new format also includes a new section on "Medical Education" and a new section on "Medical Research." The new format is designed to make the Journal more readable and more useful to its readers.

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A reference to figure seven makes clear the method of piping employed to make possible the use of both the continuous indicator and the two ordinary indicators with which it was to be compared. At each end of the cylinder are pipes carrying tees at the upper end. Of the three branches of each tee one leads to the cylinder, another to the continuous indicator and the third to an ordinary indicator. It will be seen that the continuous indicator is maintained constantly in communication with the two ends of the cylinder and that the ordinary indicators can be cut off from such communication it will by means of the indicators cocks, which are clearly shown. As will be seen, the continuous indicator is connected to the reducing motion by means of a cord.



Figure 8.

Figure 8 shows clearly the brake used to absorb and to measure the engine load. It is a block and band brake of the well known prony type. For this type of brake

$$\text{B.H.P.} = \text{Brake horse power} = \frac{2\pi r W N}{33000}.$$

Where r = distance from center of brake wheel to the point of application of the load

W = effective load on scale in pounds and

N = revolutions per minute of engine.

The knifeedge was so adjusted that $2\pi r$ became equal to 33 feet, reducing the formula for brake horse power to the form

$$\text{B.H.P.} = 33WN / 33000 = WN / 1000$$

One test serve to shew, however, that the continuous indicator to be tested could not be satisfactorily driven by a flexible cord connection to the reducing motion. At high speeds the spring S (Fig. 3), even when given the maximum tension possible, was not quick acting enough to give the full stroke to the recording drum. A question was also raised as to the just comparability of results obtained by use of a continuous indicator to those resulting from taking the average of several horse powers obtained from cards taken at intervals with ordinary indicators.

Because of the difficulty experienced in driving the recording drum of the continuous indicator by means of the spring S and a flexible connection between the drum and the reducing motion, a steel rod one eight inch in diameter was substituted for the cord and a positive drive assured. The method of driving the drum of the continuous indicator and the two ordinary indicators is clearly shown in figure nine.

The cord driving the drums of the ordinary indicators is so attached to the arm of the reducing motion that when the engine is at mid-stroke a perpendicular from the center of rotation of the reducing motion to the cord will meet the cord at the point of attachment.

In order to meet the objection implied by the question

It is a pleasure to have you here.

I am very glad to see you.

The meeting was an adjournment of the previous one.

Resolving the matter for the time being.

Very truly yours,

One last note is made, however, that the committee

will be held in the building at 1215

and connected to the building at 1215

It is, I think, a very good idea to have

the meeting held in the building at 1215

I would also like to see the committee

at the meeting held in the building at 1215

at the meeting held in the building at 1215

because of the difficulty of finding

the room at the building at 1215

the committee at the building at 1215

and the right to the building at 1215

positive order of the building at 1215

known to the building at 1215

in the building

The next day the group of the building at 1215

is attached to the group of the building at 1215

is an indication of the building at 1215

Resolving the matter for the time being

Very truly yours,

It is a pleasure to have you here.

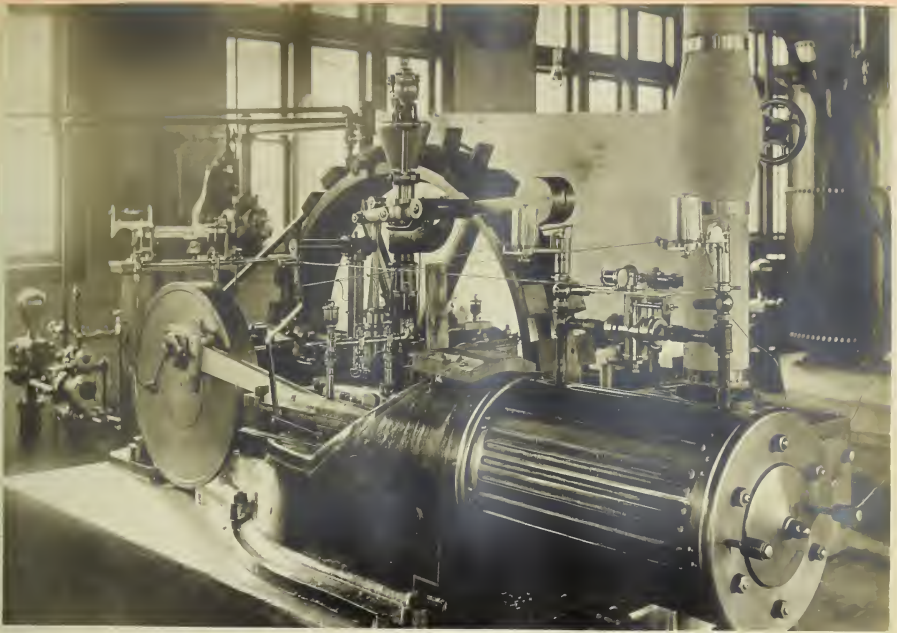


Figure 9.

regarding the comparability of results obtained by the continuous indicator to those obtained by taking the average of the horse power worked up from cards taken at intervals, an Oliver Automatic Recording Machine was attached to the engine as shown in figure ten.

This machine gives a continuous record of the performance of the engine and will be more fully described later.

Figures number nine and ten, together with the view of the brake shown by figure number eight, will serve to give a clear idea of the manner in which the engine was rigged up for the tests.

A more detailed description of the instruments used and methods employed, together with a summary of results, follows.

The continuous indicator has been described previously and it has been shown that the reading on the dial is proportional to the work done by the engine. We will now develop a horse power

regarding the comparability of results obtained by the comparison
indicator to those obtained by testing the system at the same time
worked up from each case at intervals, an Oliver August 1911
bearing witness was attached to the engine as shown in Figure 10.
This machine gives a continuous record of the performance of the
engine and will be more fully described later.

Figure 10 shows the engine and the indicator with the view of
the system shown in Figure 10, which will serve to give a clear
idea of the manner in which the engine was tested up for the
A more detailed description of the indicator and the engine
engines, together with a summary of results, follows.

The indicator has been described previously and
it has been shown that the results on the trial in comparison
the work done by the engine. We will now describe a few of the

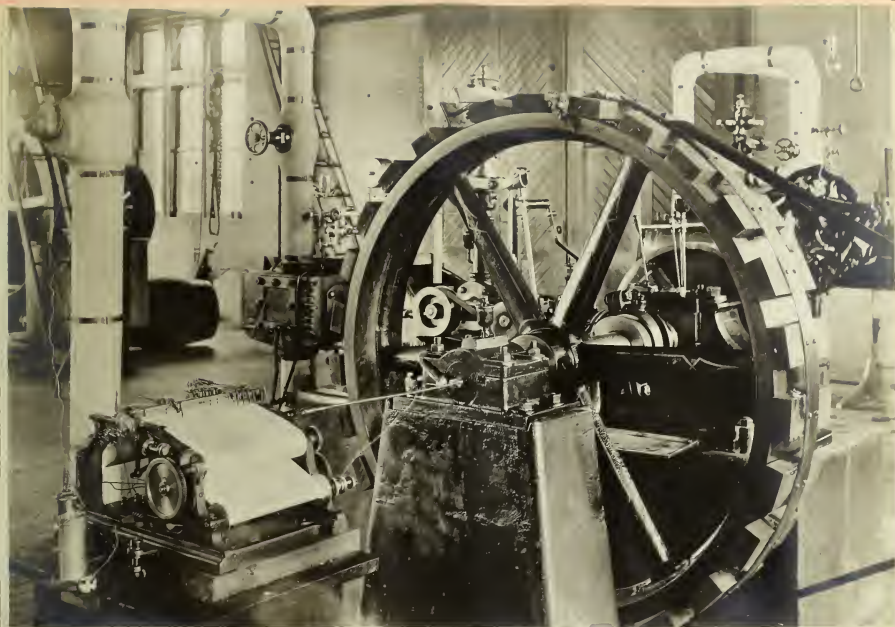


Figure 10

constant for this indicator . In this indicator,

Circumference of recording drum = 3.125 inches.

and one revolution of counter = 8 revolutions of the drum.

Then one revolution of the counter is the equivalent of one revolution of a recording drum of twenty-five inches circumference.

Now let

t = Total time
of test in
minutes.

r = Revolutions
of counter.

s = Stroke of
drum in
inches.



Figure 11

... .. In this instance,

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

... ..

l = The length of a line perpendicular to both the center of the piston rod P (Fig. 11) and the axis of rotation of the frame carrying the wheel W . = 1.442 inches.

S = Scale of spring. (Pounds pressure to move piston one inch)

N = Revolutions per minute of engine

Q = Strokes per minute of engine = $2N$

and C = Average engine constant = $1/2 (A_1 L / 33000 + A_2 L / 33000)$

By the well known formula for horse power

$$H.P. = P L A_1 N / 33000 + P L A_2 N / 33000 = 2 P C N$$

where P = The mean effective pressure.

With the continuous indicator,

Total effective pressure for one revolution of counter =

$$25 \times S \times l / s$$

$$M.E.P. \text{ for one revolution} = 25 \times S \times l / s \times 2N \times t$$

And the horse power for any length of time

$$= H.P. = 2 P C N = 2 \times 25 \times S \times l \times C \times N / s \times 2N \times t =$$

$$25 \times S \times l \times r \times C / S \times t$$

The Meyer engine used had the following dimensions

Diameter of cylinder = 8 inches

Stroke = 12 inches

Diameter of piston rod = 1.5 inches

$$\begin{aligned} A_1 L / 33000 &= 8 \times 8 \times .7854 \times 12 / 33000 = .0015232 \\ A_2 L / 33000 &= (8 \times 8 \times .7854 - 1.5^2 \times .7854) 12 / 33000 = .0014696 \\ \text{Therefore } C &= .0015232 + .0014696 / 2 = .0014964 \end{aligned}$$

The engine was so rigged that the stroke of drum became 1.153 inches, reducing l/s to the quantity $1.442/1.153 = 5/4$

The springs used were all carefully calibrated with the following results

Spring number one (a Tabor spring marked 50 pounds) 48.31

Spring number two (a Tabor spring marked 100 pounds) 100.00

[illegible]

As the Tabor pencil motion gives an ordinate on the indicator card which is five times the motion of the indicator piston, the actual scales for these springs when applied to the continuous indicator are as follows:

For spring number one - - - - - 241.55

For spring number two - - - - - 500.00

The horse power formula then becomes,

For spring number one,

$$\text{H.P.} = 25 \times 241.55 \times 5 \times r.x.0014964/4t = 11.2949 \text{ r./t}$$

And for spring number two,

$$\text{H.P.} = 25 \times 500 \times 5 \times r.x.0014964/4t = 23.3818 \text{ r./t}$$

The indicators used were of the well known Crosby type, indicator number 2593 being used on the head end and indicator number 3310 on the crank end. The springs used in them were carefully calibrated with the following results

Spring number one (used in 2593) -- 59.46

Spring number two (used in 3310) -- 58.37

Next will be described briefly the apparatus for calibrating the springs used in connection with the tests. A view of it is shown in figure twelve. The apparatus consists of a steam drum having a pressure regulating valve which operates in such manner as to maintain a constant pressure in the drum, this pressure being dependent upon the number of weights placed on the pan. In case the pressure becomes too high the valve, shown at the left of the drum, is forced up by the pressure, increasing the area of port-opening through which the steam is allowed to escape. With this valve no difficulty was experienced in maintaining any desired pressure in the drum. The valve is so constructed that when no weights

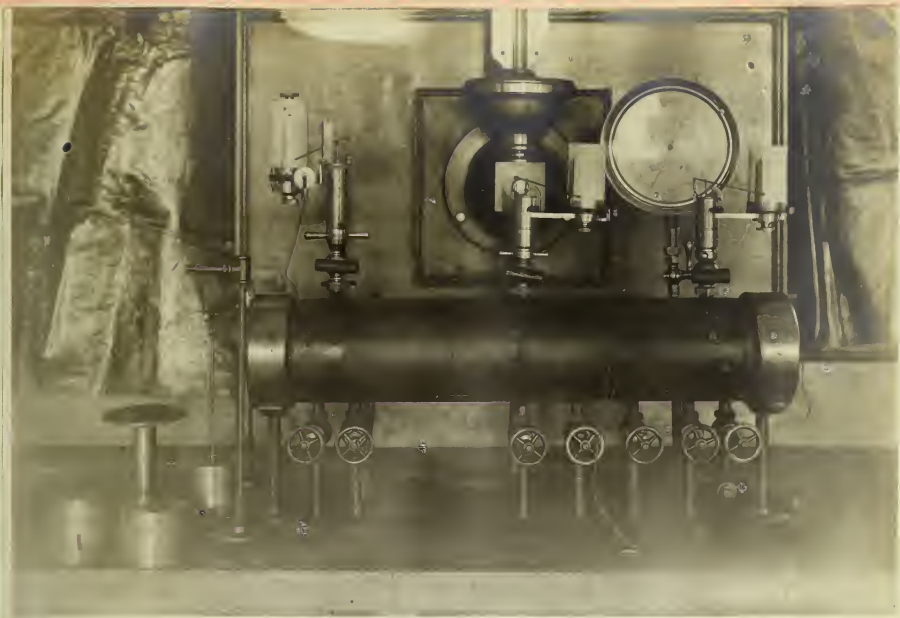


Figure 12.

are on the pan five pounds pressure is maintained. The gauge shown in the figure is the Standard Test Gauge of the University of Illinois which was used to check the pressure in the drum. The method of attaching the indicators is clearly shown in the figure and requires no detailed description.

The automatic recording machine used was designed to record on a continuous strip of paper the momentary changes of conditions throughout the test, this producing a sort of graphical log to be used as a basis of calculation for the final results.

* Figures number thirteen, fourteen and fifteen show front rear, and overhead views of the machine and figures number sixteen and seventeen show some of its details. It consists essentially of two parts: the paper feeding mechanism and the recording me-

* From paper by E. C. Oliver in American Machinist, Feb. 27, '02

one in the new time period is indicated. The time shown in the figure is the standard time shown in the figure at the point which was used to obtain the pressure in the drum. The pressure of obtaining the indicator is shown in the figure and the figure is indicated as follows.

The automatic recording machine was designed to record on a continuous strip of paper the summary changes of conditions throughout the test, this provided a part of the record and as a basis of calculation for the final results.

* Figure number thirteen, fourteen and fifteen show first, second and third views of the machine and figure number sixteen and seventeen show some of the details. It contains a description of the machine, the power feeding mechanism and the recording mechanism. The figure is indicated as follows.

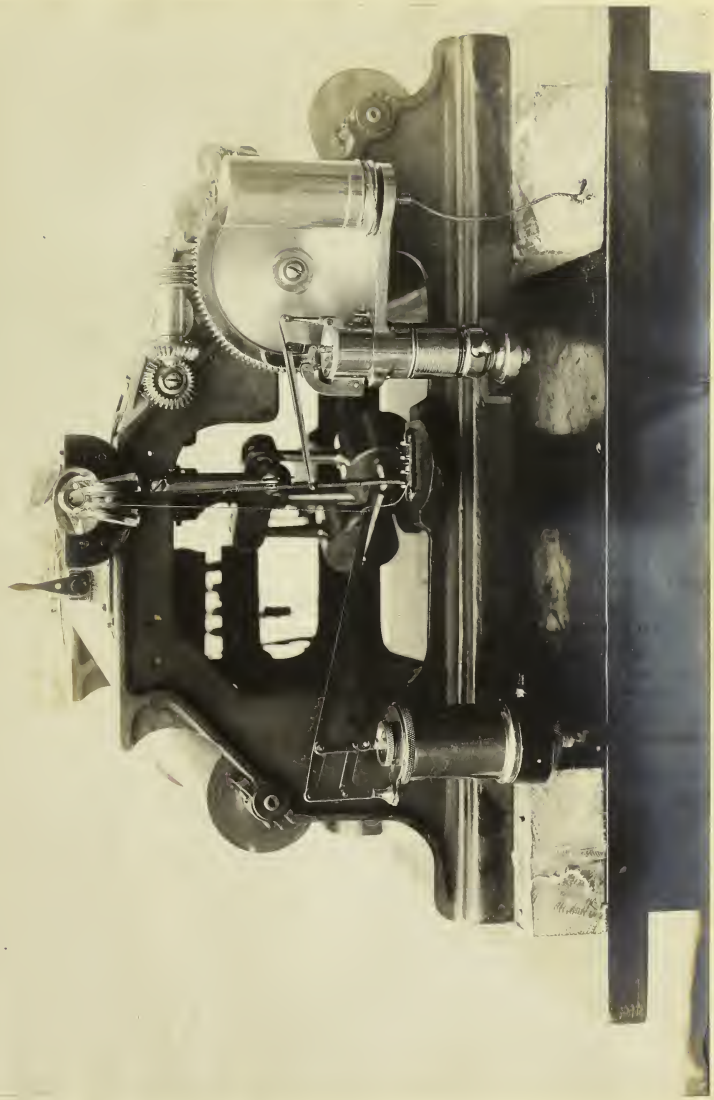


Figure 13

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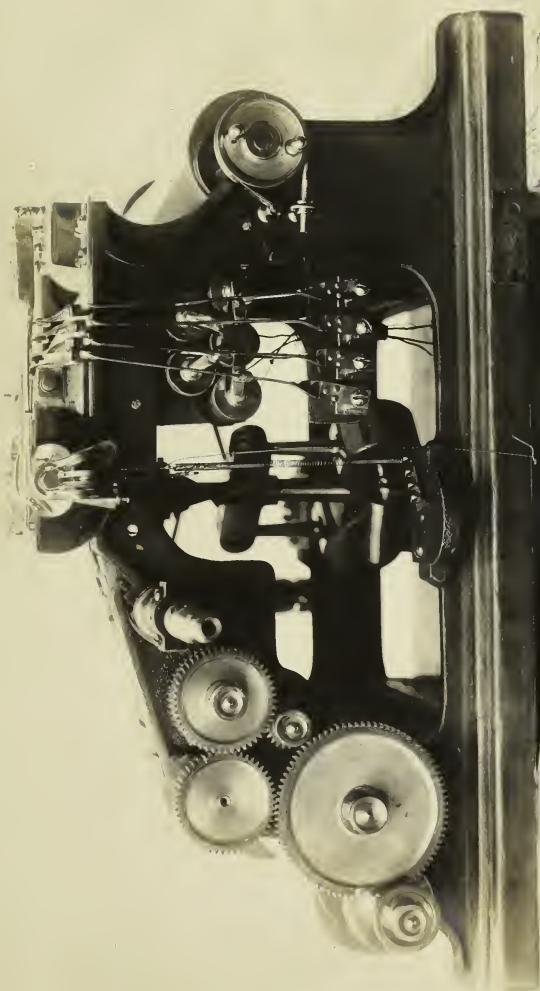


Figure 14.

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chanism. A supply of paper is carried on a roll supported by shaft A, figure four. The sheet is led upward over a horizontal brass plate, to a pair of rolls E and F, over which it passes in an Cshape, to give the friction necessary for feeding. From these rolls it passes to a receiving roll on shaft H. The paper is fed forward by the motion of the engine under test, connection being made between the engine shaft and driving shaft B of the machine by a light steel rod. The driving shaft B extends to the opposite side of the machine, where its motion is reduced through a worm and gear in the ratio of 100 to 1. A pinion D on the shaft with this worm gear but on the front of the machine engages a gear on the feed roll E. (The worm shaft is vertical in figure sixteen, but horizontal in figure thirteen.) The paper therefore travels forward with a speed proportional to the speed of the driving shaft.

This speed may be varied as necessary by using gear of different ratio between D and E.

The two feed rolls are driven together by gears E and F and the receiving roll H is driven from the gear F through an idler G. A friction device between the gear on H and its shaft, shown in detail in figure seventeen, accommodates the speed of rotation to the increasing diameter of the roll. The tension on the paper in front of the rolls is adjusted by means of this friction device, and the tension behind the rolls is adjusted by means of a band brake on A. A positive acting clutch interposed between two sections of the shaft B allows the feeding mechanism to be stopped and started at will.

The record is made as the strip of paper passes under a number of pens on top of the machine, the general arrangement being shown in figure fifteen. There are twelve of these pens

with between 2 and 3.

On the 10th of the month of June 1907, the following was received from the Hon. J. H. ...

The tooth is made in the shape of paper pattern with a

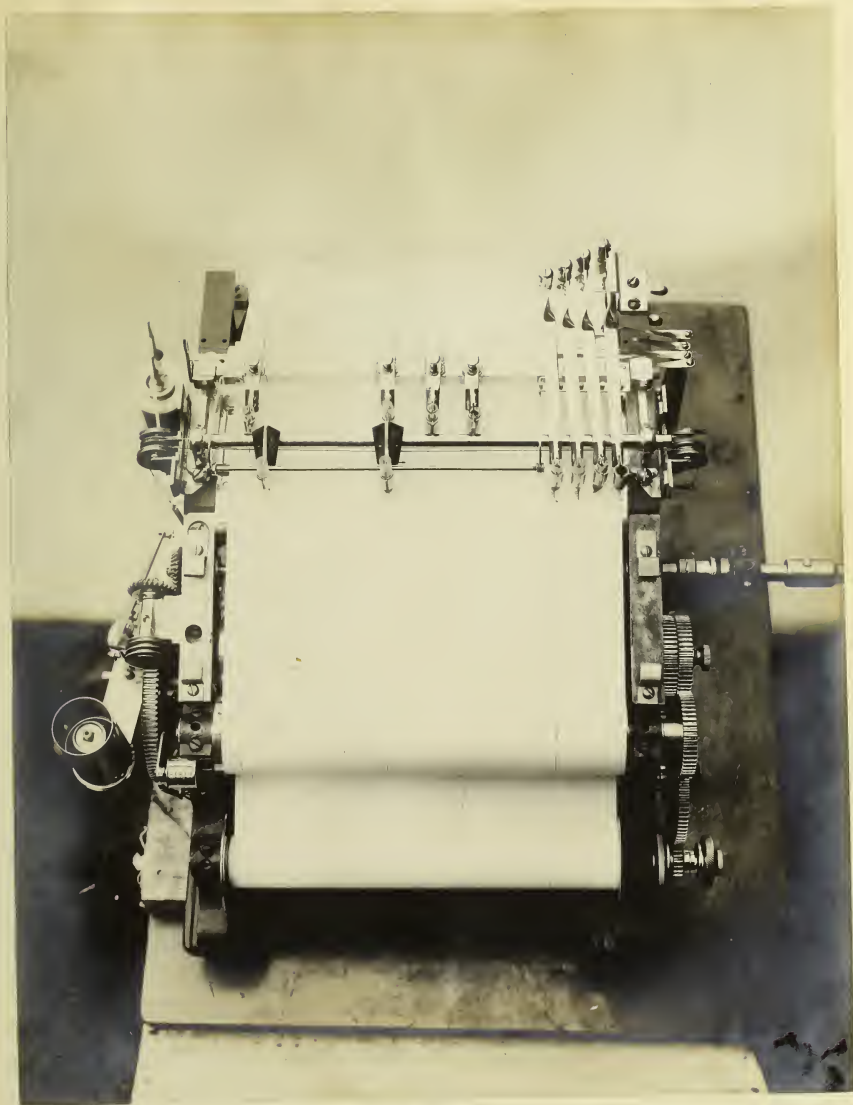


Figure 15.

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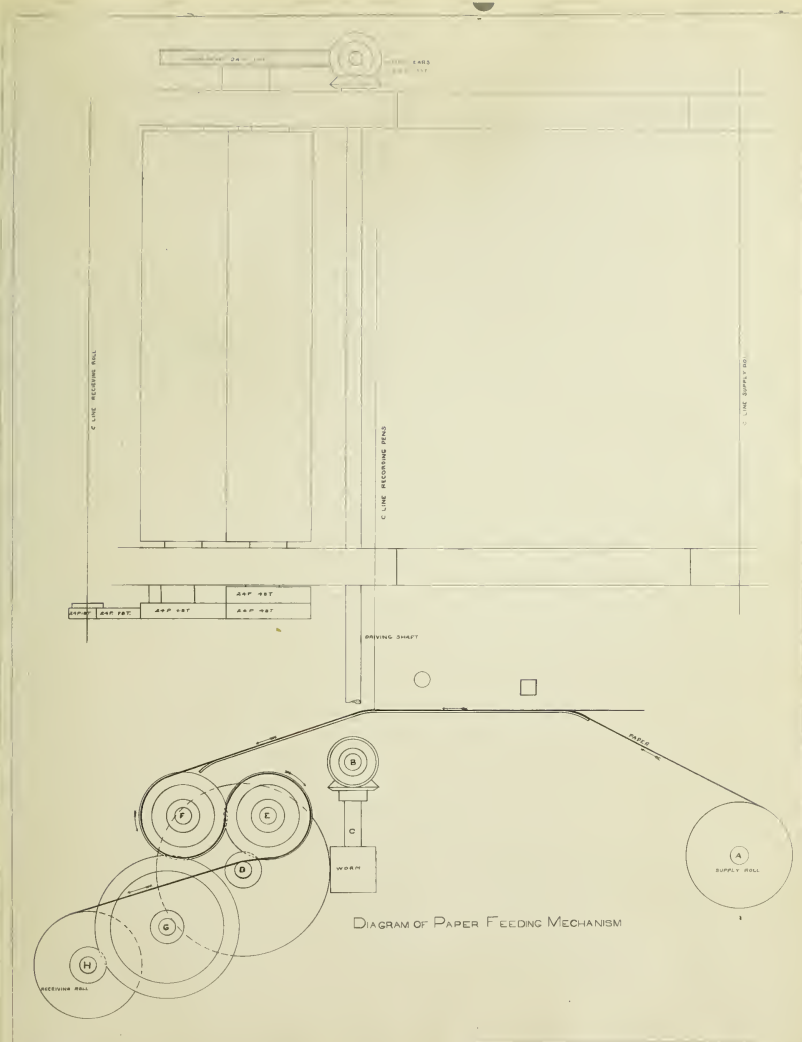


Figure 16.

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available for taking eight readings. The pens shown on the rear bar are for tracing base lines for the movable pens in front. The four pens to the right are connected through a system of levers to the armatures of electro-magnets, so that the closing of a circuit will cause one of these pens to shift, thus indicating by a jog in the line some movement a record of which is desired. The pens at the left are held in runners which slide on a circular bar. They are actuated by light cords attached to the under side and led over pulley on either side of the machine to a moving part the extent of whose movement it is desired to record.

The pens are shown in detail in figure seventeen. The pen proper is in the form of a small tube and bears against the paper at an angle. The supply of ink is carried in a well just behind the pen, the flow being obtained by means of very small wicks which extend from the bottom of the well to ~~the~~ point of the pen.

In the electrically operated pen the joints between the several levers are made by strips of very thin spring steel, thereby obviating much of the friction and lost motion of pin joints.

The pens may all be simultaneously raised from the paper by the action of a lever at the side of the machine.

Typical records may with this machine are shown in figures number eighteen and number nineteen. Figure number eighteen is a portion of the record from a test of an Otto gasoline engine.

The upper line is made by connecting the terminals of one electro-magnet to a clock which makes contact at stated intervals, fifteen seconds in this case. The second line is made by attaching a brass contact piece to the engine in such manner that the lever which injects the gasoline charge will strike it at each injection, thus causing the pen connected with it to make a jog and

very much as if it were a piece of paper, and the only thing that would be left of it would be a piece of paper.

[illegible]

The first may be simultaneously raised from the paper to the

...of the

The upper line is made by connecting the terminals of the two
resistors to a single point which is connected to ground.
The lower line is made by connecting the terminals of the two
resistors to a single point which is connected to ground.
The upper line is made by connecting the terminals of the two
resistors to a single point which is connected to ground.
The lower line is made by connecting the terminals of the two
resistors to a single point which is connected to ground.

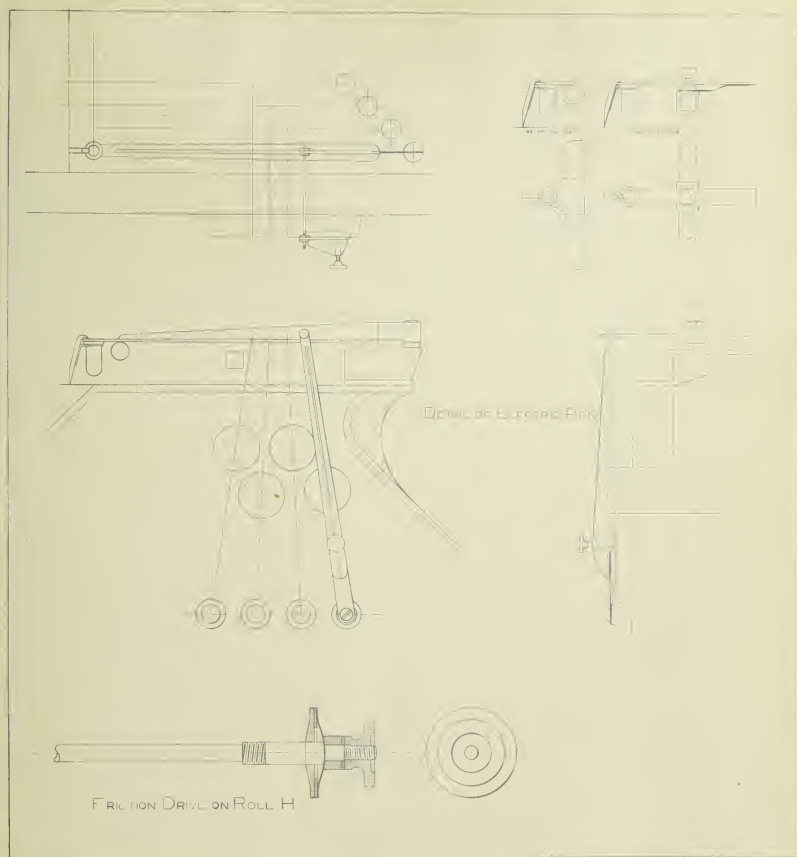


Figure 17.

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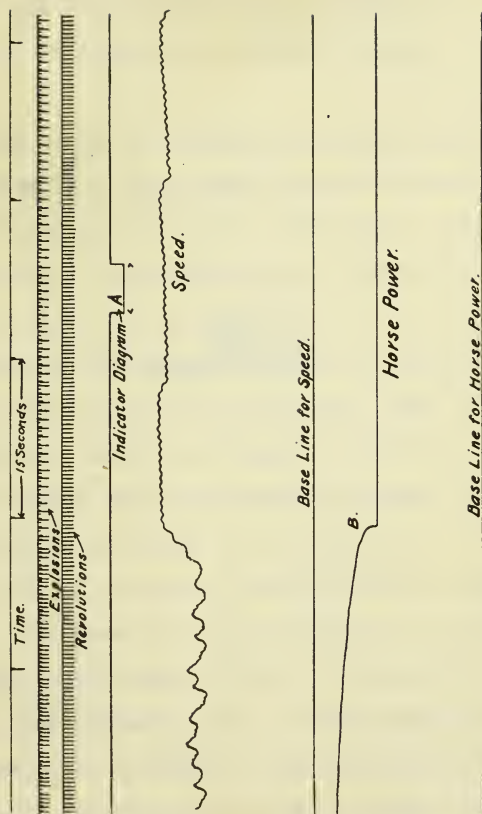


FIG. 18.—TEST OF AN OTTO GASOLINE ENGINE.

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108
indicate an explosion. The third line represents revolutions, contact being made at each revolution of the side shaft, each mark representing one cycle or two revolutions of the engine. To make the fourth line, a push button is attached to the indicator in such a way that when the pencil is pressed against the paper, electric contact is made and the recording pen is pushed out, in which position it remains so long as the indicator pencil is in contact with the paper.

The speed curve is obtained by connecting one end of a cord to an arm actuated by a centrifugal governor mechanism shown in figures number thirteen and fourteen. This cord extends upward over a light pulley across the machine over a similarly placed pulley and downward. A light spring connected to this end of the cord effects its return motion when drawn in the opposite direction through the action of the speed mechanism. Near the middle of this cord is attached the runner carrying the speed pen. Any movement of the governor below, due to a change of speed, will instantly cause a corresponding movement of the pen above.

The method of obtaining the line representing horse power is as follows. The brake arm rests directly on the piston of a hydraulic cylinder, the area of which is one half of a square inch. A small pipe connects this cylinder with the cylinder of a steam engine indicator attached to the side of the recording machine.

The system being filled with oil, any pressure imposed by the brake will be transmitted to the under side of the indicator piston, raising it against the usual spring. The upward movement of the arm is thus a measure of the pressure at the end of the brake arm and consequently of the horse power. The movement is transmitted to the pen above by means of a cord in the same manner

[illegible][illegible]

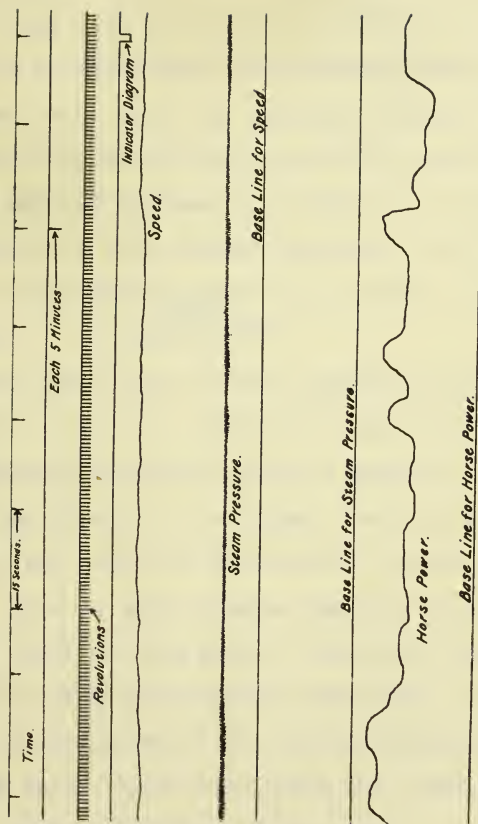


FIG. 12. — TEST OF A CORLISS STEAM ENGINE.

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that the speed is indicated.

Figure number nineteen shows a portion of a record taken from a Corliss engine furnishing power for a street railway.

The first five lines were made by methods similar to those used in the gasoline engine test. The steam pressure was obtained by connecting the steam pipe just above the throttle with the indicator used in the previous test for recording horse power. The line representing horse power was obtained through the motion of the engine governor by connecting a cord to a vertically moving arm. This cord was led by means of pulleys to a pen on the machine in a manner similar to that already explained. Thus any movement of the governor was instantly shown by a movement of the recording pen on the paper.

This line then really gives a record of governor positions; yet, as cut-off is directly affected by the position of the governor and as the mean effective pressure depends on the cut-off, provided the steam pressure is constant, the same position of the governor will at any time give practically the same mean effective pressure. The curve is calibrated by taking a number of indicator diagrams during the test, the time at which they were taken and the governor position being automatically recorded. In this way the horse power may be computed for the various governor positions and a scale made which, when moved along the line, will show the horse power for each revolution, if necessary.

The records are by means of this machine all traced to the same scale of time or of distance and all collected on a single sheet, thus greatly facilitating the processes of computation and at the same time greatly decreasing the liability to error due to incorrectly marking the several individual records.

For original version by Bennett, see 1994 in this collection.

Received 10 May 2006; accepted 10 May 2006

Received 10 June 2004; accepted 12 July 2004

[illegible][illegible]

These power law relationships are:

In the tests run in connection with this thesis the steam pressure was practically constant for each test, as was also the load.

This latter fact is shown by the form of the line showing governor positions, which during each test remained parallel to its base line. This made it possible to make a comparison between the horse power results by the continuous indicator and the results obtained by computation from the cards taken with the Crosby indicators.

On the following pages will be found the tabulated results of the tests run to determine the accuracy of the continuous indicator compared with that of indicators of the ordinary type.

Table number twenty-six is a comparison of the results for average horse power from seven tests as obtained by use of ordinary indicators and by means of the continuous indicator. These tests were run on April 26, 1902. Table number twenty-seven gives like information regarding a second series of seven tests run on May 15, 1902. Figure number twenty is a graphic representation of the results recorded in tables number twenty-six and number twenty-seven.

By inspection of figure twenty we see that for each series the points showing the relation between the average horse power by the continuous indicator and by ordinary indicators lie upon a straight line. For each series there is found one point which does not fall on the line joining the remaining points; but as in each case the point in question is the result of only a few readings (two in one case and three in the other) the author feels justified in disregarding it.

The straight lines representing the relation between the values for average horse power obtained with the continuous indi-

[illegible]

TEST OF CONTINUOUS INDICATOR
RUN ON
MEYER AUTOMATIC ENGINE. UNIVERSITY OF ILLINOIS.
APRIL 26, 1902.

THE UNIVERSITY OF CHICAGO

CHICAGO, ILL.

DEPARTMENT OF CHEMISTRY, UNIVERSITY OF CHICAGO

APRIL 22, 1934

TEST OF CONTINUOUS INDICATOR.

RUN ON

MEYER AUTOMATIC ENGINE. UNIVERSITY OF ILLINOIS.

E.C. OLIVER

OBSERVERS: C.C. HIGGINS

APRIL 26, 1902.

HUGO LUND

No.of Test	No.of Cards	M.E.P. H.E.	M.E.P. C.E.	Sum	R.P.M.	I.H.P.	Ave. I.H.P.	Ave. I.H.P.
1	1	18.53	25.70	44.23			by Cards	by
"	2	18.33	27.66	45.99	222	15.31		Con. Ind.
"	3	19.10	26.93	46.03	224	15.49		
"	4	17.44	26.14	43.58	222	14.57		
"	5		27.52					
"	6	18.49	26.07	44.56	218	14.59		
"	7	18.69	26.33	45.02	221	14.91		
"	8	17.83	25.34	43.17	221	14.31		
"	9	17.89	26.40	44.29	221	14.68		
"	10	17.92	27.19	45.11	222	15.03		
"	11	18.16	26.59	44.75	223	14.92		
"	12	17.40	26.53	43.93	220	14.50		
"	13	18.31	26.92	45.23	222	15.10		
"	14	18.71	27.12	45.83	220	15.17		
"	15	18.49	26.73	45.22	223	15.13		
"	16	18.09	26.73	44.82	221	14.86		
1	17	18.29	27.13	45.42	218	14.84	14.89	15.71
2	18	11.14	19.99	31.13	228	10.63		
"	19	11.94	20.20	32.14	229	11.04		
"	20	12.34	21.28	33.62	226	11.42		

• **Figure 1.23** •

No. of	No. of	M.F.P.					Ave.	Ave.
Test	Cards	H.E.	C.F.	Sum	R.P.M.	I.H.P.	I.H.P.	I.H.P.
2	21	12.01	20.29	32.30	222	10.75	by Cards	by
"	22	13.60	20.09	33.69	213	10.75		Con. Ind.
2	23	13.13	20.68	33.81	228	11.57	11.03	12.46
3	24	27.47	35.44	62.91	210	19.80		
"	25	27.54	33.86	61.40	210	19.35		
"	26	26.97	34.28	61.25	210	19.30		
3	27	27.84	33.86	61.70	211	19.58	19.51	19.18
4								
4	28	34.97	41.18	76.15	210	24.00		
"	29	32.34	40.00	72.34	210	22.80		
"	30	32.40	39.79	72.23	211	22.90		
"	31	32.40	37.20	69.60	212	22.17		
4	32	34.80	39.99	74.79	211	23.70	23.11	22.36
5	33	39.80	47.52	87.32	212	27.80		
"	34	40.81	47.28	88.09	211	27.90		
"	35	40.80	48.86	89.66	211	28.41		
"	36	40.00	52.93	92.93	209	29.18		
5	37	40.20	45.94	86.14	207	26.80	28.01	26.01
6	38	44.62	50.29	94.91	190	27.10		
"	39	43.82	49.50	93.32	192	26.91		
6	40	42.61	50.69	93.30	190	26.62	26.88	25.99
7	41	54.53	59.78	114.31	199	34.20		
"	42	46.83	53.86	100.69	197	29.71		
7	43	46.17	53.26	99.43	199	29.80	31.24	26.93

NOTE- Average constant for engine = .0015 Steam pressure practically constant at 116 pounds.

TEST OF CONTINUOUS INDICATOR
RUN ON
MEYER AUTOMATIC ENGINE. UNIVERSITY OF ILLINOIS.
MAY 15, 1902.

NOTARSKI WOPRZYJAS DO TWT

DO KTY

,KIMPLAI NO YTKRPPIN) ,PPICH OTANOTLA OTCH

,2021 ,31 TMA

42

TEST OF CONTINUOUS INDICATOR

RUN ON

MEYER AUTOMATIC ENGINE. UNIVERSITY OF ILLINOIS.

W.C..CARTER

OBSERVERS:- L.A. STEVENSON

MAY 15, 1902

HUGO LUND

No.of Test	No.of Cards	M.E.P. H.E.	M.E.P. C.E.	Sum	R.P.M.	I.H.P.	Ave. I.H.P.	Ave. I.H.P.
1	1	17.76	22.01	39.77			by Cards	by
"	2	18.15	22.79	40.94				Con. Ind.
"	3	19.35	22.99	42.34	204	12.96		
1	4	18.95	22.19	41.14	195	12.05	12.50	10.32
2	5	11.17	18.67	29.84				
"	6	10.97	19.65	30.62	243	11.16		
"	8	11.37	18.47	29.84	215	9.62		
2	9						10.34	15.12
3	10	25.14	33.21	58.35	212	18.56		
"	11	26.13	34.19	60.32	210	19.01		
"	12	25.14	33.21	58.35	207	18.09		
3	13	24.94	31.83	56.77	212	18.06	18.43	22.90
4	14	32.32	39.30	71.62	213	22.92		
"	15	32.32	39.89	72.21	208	22.53		
4	16	32.52	39.10	71.62	213	22.92	22.79	26.64
5	17	36.91	41.85	78.76	190	22.45		
5	18	33.72	45.78	79.50	202	24.09	23.27	26.91

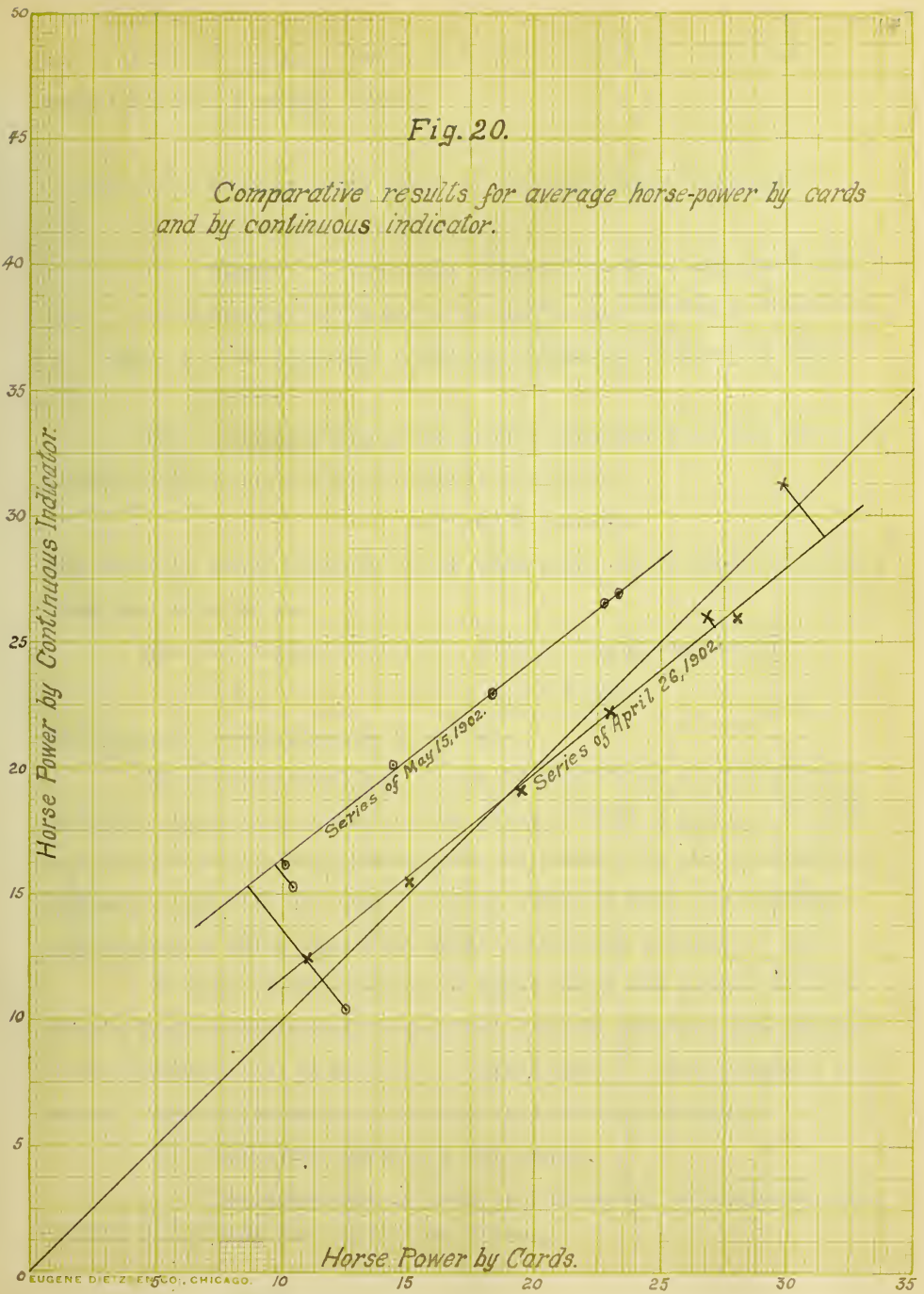
113

No.of	No.of	M.E.P.	M.E.P.				Ave.	Ave.
Test	Card	H.E.	C.E.	Sum	R.P.M.	I.H.P.	I.H.P.	I.H.P.
6	19	11.97	18.47	30.44	211	9.65	by Cards	by
"	20	11.57	19.06	30.63	224	10.29		Con. Ind.
"	21	10.77	19.85	30.62	225	10.32		
6	22	10.37	18.67	29.04	225	9.93	10.05	16.14
7	23	17.96	25.74	43.70	216	14.16		
"	24	18.55	24.56	43.11	224	14.48		
"	25	18.15	24.76	42.91	215	14.37		
"	26	17.96	25.15	43.11	225	14.53		
"	27	18.55	24.96	43.51	216	14.10		
7	28	18.35	25.94	44.29	220	14.62	14.38	20.05

NOTE - Average engine constant = .0015 Steam pressure practically constant at 115 pounds.

Fig. 20.

*Comparative results for average horse-power by cards
and by continuous indicator.*



cator and with ordinary indicators may be given by the general equation for a straight line,

$$y = m x + c$$

where y = Average horse power by the continuous indicator,
expressed as ordinates,

m = Tangent of the angle between the line and the X axis,

x = Average horse power by cards, expressed as abscissae,

and c = An arbitrary constant, being the value of y when
 $x = 0$.

For the line joining the points obtained from the series of tests of April 26, 1902, the equation becomes

$$y = .82 x + 3.15,$$

the constant being plotted to the same scale as is used for plotting the value of y .

For the series of May 15, 1902 the equation becomes

$$y = .79 x + 8.40,$$

the constant being plotted as before.

From these equations it can be seen that, with different springs, there is a change in the value of both m and c . In case the results for average horse power obtained with the continuous indicator had been the same as those obtained with the ordinary indicators, m would have been equal to one and c equal to zero.

In view of the results of these tests the author of this thesis feels constrained to say that, in his opinion, the continuous indicator tested can not be relied upon to give accurate results. The following is a list of some of its defects.

1. The moving parts are too heavy.
2. The instrument is hard to lubricate, no adequate provision being made for oiling the piston.

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3. The instrument is destructive to springs. It is designed to use the common Tabor spring. These springs are made by soldering the ends of spiral springs to brass thimbles, one of which is screwed to the cap of the indicator cylinder and the other to the piston. After the majority of tests it was found that these soldered joints were broken. This may easily have had a marked effect upon the accuracy of the instrument.

4. Its working parts are not easily accessible for inspection or cleaning. In case any grit or dirt should get into the cylinder (and this frequently happens in some classes of work, notably in locomotive testing) it would be impossible to remove it without great trouble and an almost prohibitive loss of time.

The more serious of these defects are of such a character as to render the instrument, in its present form, of very doubtful value; and there is none of them but would seriously limit its field of usefulness. The author cannot, however, see any reason why the problem of producing a satisfactory continuous indicator cannot be solved, and believes that its solution lies in the design of an instrument with its moving parts as light as is consistent with durability and accuracy, easy of lubrication, and so constructed that, in case it becomes either necessary or desirable, they may be removed and replaced with a minimum loss of time.

INDEX.

INDEX.

	Page
Causes leading to design of continuous indicators- - -	1
Types of continuous indicators- - - - -	2
Description of type using record sheet - - - - -	2
Description of type recording results on the dial - - -	3
Subdivisions of thesis, with reasons for same - - - - -	5
Description of test to determine the effect on result for average horse power of the method of taking cards and of the interval between readings - - - - -	6
Description of contents of tables deduced from above test	6
Conclusions	
1. Regarding effect of change of interval - - - - -	8
2. Regarding effect of method of taking cards - - - - -	8
3. Regarding best method of taking readings - - - - -	9
Table 1. Electrical log - - - - -	10
" 2. Electrical load - - - - -	15
" 3. Revolutions per minute of engine - - - - -	18
" 4. M.E.P. and I.H.P., two minute intervals, cards taken simultaneously - - - - -	21
Fig. 6. curves for engine load, electrical load and revolutions per minute - - - - -	30
Table 5. I.H.P., 4 minute intervals, cards taken si- multaneously - - - - -	31
Table 6. I.H.P., 6 minute intervals, cards taken si- multaneously - - - - -	36
Table 7. I.H.P., 8 minute intervals, cards taken si- multaneously - - - - -	40
Table 8. I.H.P., 10 minute intervals, cards taken si-	

1. The purpose of this study is to determine the effect of the

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26. The purpose of this study is to determine the effect of the

27. The purpose of this study is to determine the effect of the

28. The purpose of this study is to determine the effect of the

multaneously - - - - - 43 II

Table 9. I.H.P., 2 minute intervals, cards taken in
rotation - - - - - 45

Table 10. I.H.P., 4 minute interval, cards taken in
rotation - - - - - 54

Table 11. I.H.P., 6 minute interval, cards taken in
rotation - - - - - 59

Table 12. I.H.P., 8 minute intervals, cards taken in
rotation - - - - - 63

Table 13. I.H.P., 10 minute intervals, cards taken in
rotation - - - - - 65

Tables 14 to 18 inclusive (Series A) Effect on re-
sult for average horse power of the interval between readings,
cards to be taken simultaneously - - - - - 68-76

Table 14. results with two minute intervals - - - - - 68

Table 15. results with 4 minute interval - - - - - 70

Table 16. results with six minute interval - - - - - 72

Tables 17. results with 8 minute intervals - - - - - 74

Table 18. results with 10 minute intervals - - - - - 76

Tables 19 to 23. inclusive. (Series B) Effect on result
for average horse power of the method of taking cards- - - - - 78-86

Table 19. results with two minute intervals - - - - - 78

Table 20. results with 4 minute intervals - - - - - 80

Table 21. results with 6 minute intervals - - - - - 82

Table 22. results with 8 minute intervals - - - - - 84

Table 23. results with 10 minute intervals - - - - - 86

Tables 24 and 24 A. a summary of the results of Series A.

Results are given in actual average horse powers and also by
making the results for two minute intervals unity and expressing

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results for the other intervals as decimal parts thereof - - - -88

Tables 25 and 25 A. a summary of the results of Series B.

Results are given in actual average horse powers and also by making the results for simultaneous readings unity and expressing results obtained by taking cards in rotation as decimal parts thereof - - - - - 89

Tests of a continuous steam engine indicator - - - - -90

Original scheme for tests - - - - - 90

Engine used in tests - - - - - 90

Method of rigging engine for tests - - - - -90

Brake used on engine - - - - - 91

Horse power constant for brake - - - - -91

Change in manner of rigging engine for test - - - - - 92

Description of instruments used in tests and of methods employed - - - - - 93-107

1. Continuous indicator - - - - -93

Horse power constants for same - - - - -94

2. Horse power constants for Meyer engine - - - - - 95

3. True scales of springs used - - - - - 95-96

4. Spring testing apparatus - - - - -96

5. Oliver automatic recording machine - - - - - 97

Records from same - - - - - 105-107

Description of tables 26 and 27 - - - - - 109

Description of figure 20 - - - - - 109

Table 26. comparative results for average horse power by cards and by continuous indicator. Results for Series of April 26, 1902 - - - - - 110

Table 27. comparative results for average horse power by cards and by continuous indicator. Results for Series of

May 15, 1902 - - - - - 112

Fig. 20 a graphic representation of the comparative re-
sults for average horse power by cards and by continuous in-
dicator - - - - - 114

Discussion of results obtained from tests of continuous
indicator - - - - - -115

Conclusions deduced from results of tests - - - - - -115





